

# Aviation Week & Space Technology


75 Cents

A McGraw Hill Publication

November 25, 1963

**Firms Propose  
Still Cameras  
For Lunar Use**

**Apollo Escape Tower Separates  
From Capsule in Abort Test**



**Canadair Completes CL-84 Transport Design**



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ASTRIONICS DIVISION / Azusa, California

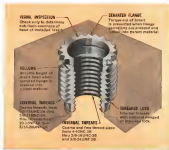
How the **NEW**

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THREADED INSERT



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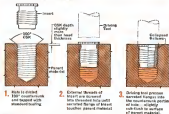
Here's a completely new insert, the one-piece HI-SERT. It provides high load-bearing threads for castings or plate material such as aluminum, magnesium, or zinc.

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Circle 10



**Burroughs Corporation**



## AEROSPACE CALENDAR

(Continued from page 5)

- Dec. 15-16—National Vendor Meeting, Space and Flight Equipment Assn., San Diego Aerospace Museum, San Diego.
- Dec. 18-17—Conference on Non-Linear Problems in the Dynamics, National Institute of Standards, Boulder Laboratories, Boulder, Colo.
- Dec. 18—50th Annual Army Aviation Congress Services Symposium, Mayberry Hall, Washington, D.C. Sponsor: National Aviation Services Assn.
- Dec. 19—Annual Meeting, American Assn. for the Advancement of Science, Cleveland, Ohio.
- Jan. 10—70th National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D.C.
- Jan. 13-17—Society of Automotive Engineers Automotive Engineering Congress & Exposition, Civic Hall, Detroit.
- Jan. 19-23—16th Annual Convention, High Speed Assn. of America, San Marino Inn, Glendale, Ariz.
- Jan. 20-23—Autospace Science Meeting, American Institute of Aeronautics and Astronautics, Hotel Astor, New York, N.Y.
- Jan. 27—60th Annual Inland Empire Quality Control Conference, American Society for Quality Control, California State Polytechnic College, Pomona, Calif.
- Jan. 27-30—23th Annual Technical Conference, Society of Marine Engineers, Club House, Haddon Hall, Hovey, Atlantic City.
- Jan. 27-29—Conference on Control and System Optimization, Monterey, Calif. Sponsor: Society for Industry & Applied Mathematics, American Institute of Aeronautics and Astronautics, Institute for Mathematical Statistics, U.S. Naval Post Graduate School.
- Jan. 27-28—Hydrogen Forum on Advances Research, University of Illinois Nuclear Engineering Research Center, Urbana, Ill.
- Jan. 28-31—44th Annual Meeting, American Mathematical Society, University of California, Los Angeles, Calif.
- Jan. 29-31—Solid Propellant Rocket Conference, American Institute of Aeronautics and Astronautics, Elko Hotel, Calif.
- Jan. 30-31—Annual Computer Applications Symposium, IIT Research Institute, La Grange, Illinois, Ill.
- Feb. 5-7—FEB: Annual Lectures in Aerospace Medicine, USAF School of Aerospace Medicine, Brooks AFB, Tex.
- Feb. 6-7—FEB: Winter Convention on Military Electronics, Institute of Electrical and Electronic Engineers, Ambassador Hotel, Los Angeles, Calif.
- Feb. 13-17—Golden Gate Monte Carlo Convention, American Society for Metals, Fairmont Hotel, San Francisco, Calif.
- Feb. 18-21—International Solid State Circuits Conference, Institute of Electrical and Electronic Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.
- Mar. 2-6—4th Conference on Applied Metallurgy (Atmospheric Problems of Aerospace Vehicles), Atlantic City, N.J. Sponsor: American Metallurgical Society, Federal Aviation Agency.
- Mar. 13—Aerodynamic Testing Conference, Maxwell-Turner Building, Dayton, Ohio. (Continued on page 9)



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## AEROSPACE CALENDAR

(Continued from page 7)

Washington, D.C. Sponsors: American Institute of Aeronautics and Astronautics, U.S. Navy

Mar. 13-16—International Convention, Institute of Electrical and Electronics Engineers, California Hall, New York 10101, New York, N.Y.

Mar. 15-17—Astronautics Boarding Conference (continued), El Taboro Hotel, San Antonio, Tex. Sponsors: USAF, Southwest Research Institute

Apr. 12—Fifth Symposium on Engineering Aspects of Magnetohydrodynamics, Institute of Electrical and Electronics Engineers, Massachusetts Institute of Technology, Cambridge, Mass.

Apr. 13—Fifth Annual Symposium and Materials Conference, American Institute of Aeronautics and Astronautics, Riviera Hotel, Palm Springs, Calif.

Apr. 14—International Conference on Non-Invasive Magnetism (Internag), Institute of Electrical and Electronics Engineers, Sheraton Hotel, Washington, D.C.

Apr. 15-16—Third International Fluid-Turbulence Symposium, College of Aeronautics, Cardiff, England

Apr. 19—Electromagnetic Compatibility & Effect on Avionics Electronic Technology Institute of Electrical and Electronics Engineers, Waldorf Astor Hotel, Phoenix

Apr. 20-May 5—1964 Cosmos Air Show, Rheine Airport, Rheine, West Germany

May 4-6—Twenty-Second Meeting, American Institute of Aeronautics and Astronautics, Cleveland, Ohio

May 4-7—American Astronautical Society's 50th Annual Meeting, "Technical Progress on Lunar Flight Program," New York Hilton Hotel, New York, N.Y.

May 5-6—Fifth National Symposium on High-Speed Flow in Electronics, Institute of Electrical and Electronics Engineers, San Diego, Calif.

May 11-14—1964 Annual National Avionics Electronics Conference (NAVECON), Institute of Electrical and Electronics Engineers, Biltmore Hotel, Dallas, Texas

May 15-16—20th Annual National Avionics Electronics Society, Sheraton Park Hotel, Washington, D.C.

May 19-21—International Symposium on Microwave Theory and Techniques, Institute of Electrical and Electronics Engineers, Atlantic City, N.J.

May 19-22—Concurrent Avionics Design & Development Meeting, American Institute of Aeronautics and Astronautics, Wichita

May 26-28—Second International Forum for Air Cargo, Sheraton N.Y. Royal Hotel, Montreal, Canada Sponsors: Society of Automotive Engineers, Aerospace Society of America and Astronautics, Canadian Association of Space Institute

June 24—National Telecommunications Conference, American Institute of Aeronautics and Astronautics/Institute of Electrical and Electronics Engineers/Infrared Society of America, Elmore Hotel, Los Angeles, Calif.

June 24—National Symposium on Global Communications (GLGCOM) VII, Institute of Electrical and Electronics Engineers, University of Pennsylvania and Bessie Hotel, Philadelphia, Pa.

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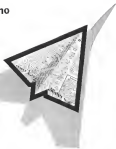
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Model 5000 - 50 Mc frequency period counter

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MODEL	TYPE	PERIOD	RANGE	TIME
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SINGLE PERIOD RANGE		0.1 to 100 ns	0.1 to 100 ns	0.1 to 100 ns
MULTIPLE PERIOD RANGE		0.1 to 100 ns	0.1 to 100 ns	0.1 to 100 ns
TIME INTERVAL RANGE		0.1 to 100 ns	0.1 to 100 ns	0.1 to 100 ns
INPUT SENSITIVITY		0.1 to 100 ns	0.1 to 100 ns	0.1 to 100 ns
INSTRUMENT ACCURACY		0.1 to 100 ns	0.1 to 100 ns	0.1 to 100 ns
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## Lessons From the Budget

The cuts imposed by Congress on the Fiscal 1964 budget for the National Aeronautics and Space Administration show clearly that the honeymoon of this crucial agency and the legislative branch is over. Last January (AW Jan. 28, p. 22), we predicted that Congress would cut the defense and space budgets submitted by the President and this has come to pass.

The \$620 million sliced from the NASA budget will not blunt the most threat of its technical programs: NASA still has a \$5.1-billion budget, the highest in its five-year history by more than a billion dollars (see p. 31).

Principal significance in the congressional budget cut lies in its reflection of the changing mood of Congress and its constituents toward the national space program. The country is not fed up with the space program, as some few pundits and scientists would have us believe. But neither is it so awed by the glamour of orbital flight that it is willing to provide a blank check for anything that is labeled "space." The fundamental feeling of the Congress this year was that it could no longer be denied by the ostentatious peritronics of NASA spokesmen about the wonders of the space age, and that it required a more realistic explanation of what NASA proposed to do with the \$5.7 billion it requested. That is the mood that will certainly continue.

Unfortunately, the NASA leadership seemed reluctant to heed sympathetic warnings from its friends that its black check tactics are obsolete, and it was left to Congress to make that point in simple arithmetic. Both the Congress and the public found their understanding of the national space policy badly confused.

One of the first steps in bolstering the space program for next year's fray is certainly a strong containment of U.S. space policy by top officials, not only to clarify the confusion generated in recent months but also to provide the proper focal point for public and congressional support. In turn, NASA needs to broaden the base of its efforts to inform both Congress and the public on its activities and goals, using more of the technical working groups to brief Congress in place of NASA Headquarters operations. It might prove wise to devote some of the seasoned astronaut's time to explaining more fully and more convincingly the purpose and scope of their exploration on the space frontier.

NASA needs to bolster its credibility factor for the

long pull. The record of only six shuttle flights thus far in 1963 in contrast to 40 scheduled launches leaves much to be desired, as does the constant overemphasis on the technical fall-out into the economy. There certainly is much fall-out, and there will be more, but the NASA superlativeness on this point has produced skeptical public reactions.

Any opposition that has of necessity grown as fast as NASA is bound to accentuate some fairly administrative layers, and these must attract attention when budgets tighten. Despite some hard raps from Congress and the press, NASA still has a predilection for scattering six-figure grants around the academic world for studies of nothing in particular. This expenditure cannot continue.

NASA has a record of solid achievement in exploring the frontiers of space technology and in laying the broad technical foundations for the program it is now pursuing. It has lifted the U.S. into a position of international leadership in every facet of space technology except manned space flight. Its achievements in space sciences have drawn international scientists to its laboratories for assistance in developing their own national space science programs.

But 1963 is a year of transition both technically and politically. The successful completion of the Mercury manned space flight project marked the end of the era when NASA had to use essentially the technical hardware it found in the military and industrial inventory when it was created. Next year, as it begins the use of Saturn boosters and tests Gemini and Apollo capsules, it will enter the era when an overall development program will reach the flight operations stage, and the true potential of our currently building space capability can be explored.

At the same time, the public transport of the space program is passing from its first tremendous flush of civilian status—generated by the Mercury successes and the challenge of the lunar landing goal—to a long, hard look at where this effort should fit into our spectrum of national goals. A great measure of the technical success of the space program in the years ahead will depend on how perspective the President and his advisers are in assessing this changing mood, and how well they develop sustained public and congressional support for this key technology over the long pull.

—Robert Hertz



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## WHO'S WHERE

### In the Front Office

**Donald E. Coig and Gerhard Neumann**, vice presidents, General Electric Co. Air Group, in general manager, Fairlane Dr., Silverdale, N.Y. Mr. Neumann, general manager, Flight Propulsion Div., Lynn, Mass.

**W. H. Peterson**, vice president in charge of the newly established System Development Dept., General Dynamics/Aircraft Division, San Diego, Calif. The department is a combination of the Advanced Product Planning and Advanced Systems Dept. F. J. Duce continues as director of Advanced Systems.

**Salvatore Straniero**, vice president and general manager, ElectroOptical Systems, Inc., Pasadena, Calif.

**Vassio M. Sotolongo**, president, Vaco Electronics, Silver Spring, Md., a division of Vaco Corporation of America.

**F. R. Picotasso**, group vice president, General Instruments Corp.'s Defense and Engineering Products Group, Hicksville, N.Y. **Stephen F. Johnson**, a vice president, Aero Corp., and president of the new International Services Div., Oakland, Calif.

**Dr. James A. Perkins**, head chairman of Carroll Annals and Laboratory, Redford, N.Y., and **Dr. Dale R. Casner**, vice chairman. Dr. Perkins is president of Case Western Reserve and Dr. Casner, president. Also elected board members of the laboratory: **Dr. Franklin A. Long**, vice president research, Cornell University, Ithaca, Conn.; **Dr. R. Perkins**, chairman, Dept. Aerospace and Mechanical Sciences, Princeton University; and **James R. Casner**, chief scientist for the Air Force.

**Robert E. Hildebrand**, controller, United Electronics, Inc., Pasadena, Calif.

**S. E. Faldut**, deputy controller of global response, Ministry of Aviation, England.

### Honors and Elections

**Joseph J. Tyness**, engineering pilot and chief of the Federal Aviation Agency's West Coast Segment Transport Office, has received the late Richard H. Heston Award for 1968 for his significant work in the field of safety and efficiency of flight testing. The award was established by United Aircraft Corp. in memory of late Richard H. Heston, Jr., and is administered by Flight Safety Foundation, Inc.

### Changes

**Dr. Howard S. Sogler**, manager, United Technology Center's Physical Sciences Laboratory, Sunnyvale, Calif.

**Robert G. Walker**, head of Litton Industries' new electronic production facility, Lakeland, Tex.

**Lawrence E. Fawcett**, deputy director chief, Propulsion Div., California Institute of Technology Jet Propulsion Laboratory, Pasadena, Calif., and **William G. Clark**, Solid Rocket Engine Engineering Section.

**Dr. Robert S. Schwartz**, director of dual engine planning, Lockheed Aircraft Corp., Burbank, Calif.

(Continued on p. 135)

## INDUSTRY OBSERVER

**Airjet-General** may propose to National Aeronautics and Space Administration's Marshall Space Flight Center that the Douglas S-68 wing, now programmed for Saturn V, be used as an upper stage on a half-length, 250-in.-dia, solid-propellant booster to achieve a high payload capability. The 250-in. motor now is undergoing feasibility demonstrations by both Airjet and Thord Chemical Corp.

**Arco Corp.** is modifying a number of its Mark IIIA recovery system, developed for the Minuteman ICBM, for use in determining the vulnerability of missile recovery systems to enemy assault. The system, which will be flight tested under a program designated Sligh Rule and prepared for later testing in a mockup environment in the event the Russians violate the current nuclear test ban agreement. Arco has a \$12-million contract for Sligh Rule from Air Force's Ballistic Systems Div.

**Vulnerability of American satellites** to interception, jamming and detection is being studied by Air Force's Space Systems Div. and Aerospace Corp. Further participation in the studies is not expected for the time being.

**North American Aviation, Inc.**, will begin testing a prototype Apollo environmental control system the first week in January. The system, developed by General Corp.'s Aerospace Div., will be installed in a prototype command module and operated in a vacuum chamber at a pressure of 10<sup>-5</sup>. Unmanned tests will be conducted with the system for about six months. Manned tests—which will include 5-, 7- and 14-day runs—are scheduled to begin June 1.

Following a study by Johns Hopkins Applied Physics Laboratory, New Haven of Weapons' Automation group has recommended to DoW/CSP special projects office that the Douglas Titan/Space General Aviation be substituted for Scout boosters in future Transit satellite program launches. Ablet, which has a contract capability for precise orbit injection tested, has been used in some Transit launches. Now has not been matched with Scout performance in the Titan program (AW Nov 11, p. 34).

Some National Aeronautics and Space Administration officials believe that the September 30 flight will be high on the list of high priority and last off that that space within five years. Proposed launch vehicles on the winged homestead-briefed and Nova vertical boost categories may absorb a substantial portion of this funding.

Langley Research Center's Lunar Orbiter payload, scheduled to take close-up photographs of the moon's surface in flights during 1968, probably will be limited to about 300 lb. The boost vehicle is programmed to be an Atlas/Agena II combination.

**Army Missile Command** and prime contractor Martin Marietta Corp. may have to reduce the requirements for the high burning rate of Hypersonic Propellant Co's propellant in the first stage of the Space Shuttle main stage. This is a compromise to ease problems that can be associated with production of the rocket motor. The high burning rate is a major factor in the shuttle's fast acceleration for intercept in the terminal phase of a reentry vehicle trajectory.

**British shipyards**, Vickers and Cammell Laird have started fabrication work on the first two Polaris submarines for Great Britain's undersea fleet. Kiel laying is scheduled next year.

**Syncom 3** communications satellite is scheduled to be the first payload launched with NASA's three-manifested Delta (TAD) boost vehicle. Launch is planned sometime next spring (AW Nov. 28, p. 38). Also being considered for boost by TAD is a Titan astronomical satellite, which is to be placed into a wide-area orbit to observe the sun. The term concept of a synchronous weather satellite. TAD is the third-generation Titan with the standard Delta second stage and a new third stage—the ABL 258—which has a higher specific impulse than the ABL 246 motor it replaces.



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### Industry Straight Talk

Aerospace leaders are warning Congress that any significant reduction in their defense business will cause the shutdown of facilities and the lay-off of workers. A consortium of their highly specialized facilities to commercial production on short notice is an impossibility, they contend.

H. M. Hovner, chairman of United Aircraft Corp., is lead-off witness for the industry in testimony before the Senate aerospace subcommittee put the situation this way: "There is already open capacity within the civilian economy... We can't put some idle price when immediately into production" to replace defense business.

Over the long term, the industry generally was optimistic that aerospace technology can be transferred to commercial production and urged that planning for the reorientation start now. Aerospace representatives told the subcommittee headed by Sen. Joseph S. Clark (D-Ia.) that a good first step would be enactment of legislation establishing a "commission on the application of new technology to community and manpower needs." The commission's job would be to determine what the economic requirements and goals for the aerospace technology could be.

Leonard Woodcock, vice president of United Auto Workers and spokesman for aerospace labor joined with industry to support the measure, sponsored by Sen. Clark, Hubert Humphrey (D-Minn.), and Philip A. Hart (D-Mich.).

### Nuclear Stockpiling

Sen. Stuart Symington—who in the past has denounced some military spending as certain waste—now forwarding law for stockpiling nuclear weapons. He also is asking the Atomic Energy Commission to disclose more details to the public about its spending, especially for new materials.

Noting the billions that have already gone into nuclear weapons and reactors, the Missouri lawmaker said "there should be some place at some time where we could refuel this gigantic and most expensive program without affecting the security of the U.S."

U.S. space agency estimates that launching its first flight in part of its own economy program will cost \$250 million over the next two years. The six flights were to test Apollo modules in earth orbit (AW Nov. 4, p. 27).

### New NASA Approach

National Aeronautics and Space Administration has promised to give its contractors greater freedom in designing components in exchange for better performance after missions are built.

Dr. Joseph F. Shea, chief of Apollo spacecraft development, said last week that NASA will concentrate less on detailed specifications and more on defining system requirements. The agency hopes this will cut confusion over responsibilities, increase reliability, and allow NASA to award more incentive contracts.

Dr. Jerome B. Wiesner last week accused Dr. Philip H. Abelson of having "a Bostonian's view of science"—comparing him to a Bostonian who told the U.S. consisted of Boston and some other territory across the Charles River. The war is answer to Abelson's charge that Wiesner had been a "cat" while White House science adviser.

Civil Aeronautics Board refused to be misled as it deliberates whether it should assume case of the cargo market for the all-cargo breakdown at the expense of loss that some passengers and cargo.

Riddle, Slick and Florig Tiger also carry on demanding fast action on their request for more economic protection. But CAR's answer is their "white paper" is not expected until next year.

Engineer Riddle, former World Bank president, is far from finished with his report for President Kennedy on the economics of the U.S. aerospace transport program. But he said he is finding little enthusiasm in industry for the proposed 75-15% cost sharing.

### TFX, Ad Infinitum

TFX dealings may extend into next year even though there are only two more trials scheduled to be conducted. Navy Secretary Fred Korth and Defense Secretary Robert S. McNamara. Tolden is getting enough of the scrutiny on the Permanent Joint/Interagency Subcommittee together.

Korth was slated to be called this week to explain those letters he wrote while Navy secretary, but the date of McNamara's appearance has not been set. Speaking dates and other commitments of the senators are working against any talk, such as the inquiry (see p. 27). The hearing record will definitely be kept open well into next year and probably beyond.

—Washington Staff



### Proposals for Navy COIN Aircraft Follow Generalized Design

Aviation Week & Space Technology's latest concept shows a general design approach followed by industry team subcontracting proposals for Navy's light center manager (COIN) aircraft (AW Nov. 11, p. 44). The design features low-altitude, short-run wings with passive electric covering most of the span to provide positive surface and high lift characteristics during short field takeoffs and landings. The aircraft is planned to carry multiple external stores, including fuel, reconnaissance gear and weapons pods. Navy has recommended two technology options—Continental T772, United Aircraft of Canada T774CF-46, Garrett Allison T7754G-2/4 and Turbofan Allison T. Three firms, however, are considering other technology proposals, such as the Allison T61 and Continental T65.

## Remote-Area Conflict Research Sought

Washington—Advanced Research Projects Agency is soliciting aerospace industry interest in a broad range of technical problems peculiar to remote area conflicts that the agency has defined during two years of combat experience and tests in Vietnam and Thailand.

ARPA will spend about \$36 million in fiscal 1964 for remote area conflict and counterinsurgency studies and research under Project Aegis (AW Sept. 17, 1962, p. 23). Although only 15% of that amount will go toward aircraft oriented projects, the agency feels the best technical talent to solve its problems is in the aerospace industry.

Robert C. Phelps, who directs ARPA's remote area conflicts office, told Aviation Week & Space Technology that the agency sees as its opening areas combat development test centers in Vietnam and Thailand; Fusion of these centers, trained jointly by native and U.S. soldiers, and civilian technicians, to identify the specific problems in these areas which require study, research or development.

#### Research on development

When these problems are defined, they become combat projects for U.S. industry and contractors. They vary in scope from an reconnaissance to anti-rocket operations.

These are the major differences between the two combat development centers.

•Vietnam is considered the "good" test area ARPA approaches research problems here from a viewpoint of what it can do on an immediate basis, and while for this country.

•Thailand is used to define and probe long-term projects, not only for this country, but for others which are large, jungle areas and which are lo-

cated with the electronic counter. When Phelps' office was established, there was concern by Air Force and Army that its functions would duplicate those of the military services. The concern was answered by identifying the service most directly affected in the research project, and then designating it both contract monitor and agent.

The Vietnamese Air Force, for example, was among a 19-member who set their major goal in B-36 aircraft, originally designed as a weapon against masses of troops and convoys. ARPA defined a requirement for a sequence to allow single, multiple and salvo strikes. The requirement was developed under USFV management.

Approximately 85% of the remote area studies are conducted under the management of a military service. ARPA monitors projects that have no service connection. Among these is a research concluded Rand analysis of

the research capabilities of small U.S. collars and antennas that can be applied to remote reconnaissance, guidance, tracking and control of night evasion and night military action.

Although ARPA is not funding any portion of the counter measures (COIN) aircraft, it is involved in the extent that it has told Defense Dept. what it has learned through its combat development experience regarding clear objectives and design philosophies most desirable for the aircraft. Cooperation for COIN production (see drawing, p. 25) is under way (AW Nov. 11, p. 47).

Phelps and ARPA is looking at the aircraft from the viewpoint of its use by local forces, supplied by the U.S. through package or military assistance.

program "We are looking for a weapon system tested by the people, the type of system the pilot will be used to [using] the air platform, with the weapon, not the best sensor for lowest cost," Phelps said.

He also feels the COIN aircraft should have a reconnaissance path, easily replaceable.

Among other studies sponsored by ARPA is one dealing with the use of the B-36 version of the Republic wing for the aircraft in Thailand. The survey found a requirement for extreme accuracy in jungle drops became a 1 to 3-m. area of the drop area required a full day's time for the troops to recover the cargo.

Army tested the wing at Ft. Benning.

## Senate TFX Probers Split on Gilpatric

By George C. Wilson

Washington—Deputy Defense Secretary Russell L. Gilpatric fought his way to a split decision in a battle with the McClellan subcommittee last week on the question of whether he should have disavowed himself from participating in the F-111 (TFX) decision because of his previous relationship with General Dynamics, winner of the \$7 billion fighter bomber contract.

Sen. John L. McClellan (D-Ark.), Henry M. Jackson (D-Wash.), Karl E. Mundt (R-S.D.) and Carl T. Curtis (R-Neb.) and Gilpatric should have disavowed himself, while Sen. Sam J. Ervin, Jr. (D-N.C.), Daniel J. Bumpert (D-Md.) and Jacob K. Javits (R-N.Y.) and Gilpatric had no obligation to do so. Sen. Edward S. Brooke (D-Me.) endorsed by his questioning of Gilpatric that he shared the latter view, although he told Aviation Week & Space Technology he would not express his opinion until after the hearings conclude. The sixth member of the subcommittee, Sen. Thomas J. McIntyre (D-N.H.), did not express an opinion.

The basic question was whether Gilpatric was so intimately associated with General Dynamics before becoming deputy defense secretary on Jan. 24, 1961, that he could not be expected to act dispassionately on a proposal to the firm—especially one involving so much money at a time General Dynamics was desperately in need of the business.

Gilpatric replied that he acted impartially at all times and that the attitude displayed by Sen. McClellan would make it difficult to attract good men into the government. He added that the former Dept. had found him free of any conflict of interest, and closed Sen. McClellan was "going for closed cases."

#### Information Gathered

Chairman McClellan said the information gathered by the subcommittee and shared by Gilpatric was far more than an occasional letter for General Dynamics, that he was a close adviser of major policy matters.

"I think that you should have disavowed yourself, and I do not think that there is any question as the world about it . . .," Sen. McClellan said. "I do not see how you can say that you could have a blind faith as this, and have this relationship with it, in the biggest contract ever so close before you, and that you could forget it had been your friend, and you could forget that you intended to return in the law firm, and you could forget that you

were under some obligation to it by past associations, and be as objective as to him and as impartial as if it was somebody you had no such associations with."

Gilpatric replied that he acted impartially at all times and that the attitude displayed by Sen. McClellan would make it difficult to attract good men into the government. He added that the former Dept. had found him free of any conflict of interest, and closed Sen. McClellan was "going for closed cases."

"I've not so sure that I'm going to be beyond it," Sen. McClellan replied. He said the Justice Dept. "is not binding on my own conscience. It is closed cases." Sen. McClellan was referring to former Navy Secretary Paul Kersh, whose resignation was believed due to a conflict of interest case (AW Oct. 28, p. 22).

Gilpatric said a proposal that he would leave his job as undersecretary in charge of security if he had refused to participate in either involving any of the main defense firms that had need for his firm.

Mr. and Mrs. Ann, and in Thailand was able to obtain the accuracy demanded by the mission with a 36-ft span and payload up to 100 lb.

Another Thailand study involves the problem of radio propagation characteristics in an area combining low-altitude, low-altitude, and jungle canopy. Ambient noise level is significantly different from an area such as Panama that the firm of Jansco and Bailey was contracted to make special studies in Thailand.

Stanford Research Institute is doing operations analysis studies in the general problem of remote area communications, down to the level of determining what communications equipment and what reaction times are required.

Sen. Ervin said, "The sole question is whether or not Senator [Gilpatric's] prior relationship of attorney-client between you and General Dynamics had imprinted in your mind in its favor which deprived you of your capacity to appear objectively." Gilpatric said no such bias was imprinted, as he would, as evidenced by documents he made since coming to the Defense Dept. that were adverse to General Dynamics. Sen. Ervin said that during his own legal career, he had defended many corporations, but did not feel that assistant he was in favor of corporate.

#### Subcommittee Documents

Stacks of documents gathered by the subcommittee staff showed that, before coming to the Pentagon, Gilpatric had played a leading role in General Dynamics' attempts to range with other firms, including 11 of 31 bidders of the contract for the General Dynamics General Dynamics Division from Nov. 13, 1953, through Dec. 21, 1960, when it was announced he would become deputy defense secretary, served as an intermediary in a dispute between General Dynamics and the Air Force over the target price for the F-102 fighter contract, wrote a letter to an Air Force general in 1959 against procurement of the General Dynamics F-4B, helped secure personnel for General Dynamics, and analyzed General Dynamics' proposals for obtaining additional defense contracts.

The subcommittee also disclosed that Gilpatric was becoming deputy defense secretary, relied on the telephone frequently with his former law partner about General Dynamics activities (AW Nov. 11, p. 17), including the selection of a successor to Frank Pace, Jr., as president of the defense firm. All of the 17 calls reported by the subcommittee were between Gilpatric and Maurice T. Mason, a senior partner in the New





AVIATION WEEK &amp; SPACE TECHNOLOGY, November 25, 1963 39



**KING AIR** is powered by Pratt & Whitney PT-5A-5 turboprop engines, with take-off and maximum continuous power rating of 500 hp plus 62 lb installed jet thrust. Triple inlet under nacelle cowling houses turbine air inlets on each side with engine air cooling inlet, center.

posed by the military department was porting his command.

The commander also will have to provide guidance to subordinate command units to assure compatibility of their command and control subsystems or elements with their own system. In addition, they will establish procedures for operating command and control facilities, alert monitoring and displaying information, schedules and priorities for communication links, computer and digital subsystems, information and documentation formats, content of computer programs and the basis of data used, and development of computer programs.

### Inverted Transit

Los Angeles—Transit navigation satellites powered by a static nuclear generator and launched this fall from the Pacific Missile Range in a orbit upside down. The satellite was one of two satellites jointly launched by the same launcher into a low-altitude earth orbit.

The inverted satellite employed the gravity gradient stabilization technique (see p. 78). The vehicle has two stable orientations, but as a consequence of its use in the unmodified orientation, its antenna is pointing away from the earth.

A consequence of this difficulty with false satellites of this type possibly could be prevented if an additional antenna pointing in the opposite direction were installed.

The latest vehicle is believed to have been a Thor Ablette launched from Vandenberg AFB Sept. 28 (see p. 23).

## \$10.8-Million Backlog Reported By Beech for Turboprop King Air

Wichita, Kan.—Firm order backlog exceeding \$10.8 million has developed for the new turboprop-powered Model 90 King Air business plane in the first 90 days since Beech Aircraft Corp.'s initial announcement of the program (AW Sept. 30, p. 14).

Industry sources say that additional orders currently being negotiated will mean this backlog substantially below the first production prototype starts its flight test program late this next month.

Acquisition of the airplane has been so rapid that the company declines to discuss its backlog in terms of units, apparently because of the volume of both a both such figures might have on potential sales because of the reluctance of customers to accept production line problems reflecting deliveries too far in the future. Beech states that the standard King Air, completely furnished with an executive interior will sell for approximately \$500,000 and that the airplane will sell for less than \$400,000 completely equipped with electronic interior, including weather radar.

First King Air deliveries to custom are now planned by next fall. Late orders are said that although the company earlier assigned a market of 100 King Airs in a five-year period beginning 1985, it has already received as production planning to consider an output of approximately 100 additional units in the period.

U. S. Army has shown considerable interest in the turboprop-powered, pressurized development of the performance Queen Air. An Army Queen Air, modified with installation of Pratt & Whitney PT-5A-5 turboprop propellers, but retain the pressurized cabin feature, has been flying on test flights since last May in an evolution of the King Air concept for future Army light utility transport operations. The turboprop has accumulated approximately 120 flight hours.

Beech management emphasizes the firm nature of the King Air program, noting that its order backlog is based on customer deposits, which it states it would not permit its distributors to accept if it had not yet made the decision to go into production.

Refined at the production prototype King Air has been tested with release of additional design details and preliminary performance data.

Although the King Air utilizes the basic Queen Air configuration, its structure has been considerably strengthened to provide for a pressurized cabin which will maintain an 8,000-ft cabin altitude at 10,000 ft, the airplane's optimum operating altitude. A four-stage blowdown driven by a turbine motor in the left engine nacelle provides cabin pressurization. A heat exchanger removes the excess heat resulting from compression. The blowdown maintains a flow rate of about 12 ft<sup>3</sup> of air per minute from its

Beech Model 90 King Air		
Estimated Performance		
Top speed	15,500 ft	203 mph
Cruise speed at 15,500 ft		270 mph
Max range with 384 gal		1,415 mi
Rate of climb at sea level, two engines		1,970 ft/min
Rate of climb at sea level, one engine		460 ft/min
Service ceiling, two engines		16,000 ft
Service ceiling, one engine		11,000 ft
Stall speed		82 mph
Acceleration-deceleration rate of climb		3,380 ft/min
Timed descent over 50-ft obstacle		2,008 ft
Landing distance over 50-ft obstacle		2,180 ft
Cross weight		9,900 lb
Gross weight		12,000 lb
Mission Profiles		
Five occupants (crew and passengers), 140 lb baggage, 384 gal fuel		
Range		1,265 mi
Speed		270 mph
Maximum time		44 hr
Max range		1,491 mi
Speed		270 mph
Maximum time		6.8 hr
Five occupants (crew and passengers), 190 lb baggage, 372 gal fuel		
Range		1,160 mi
Speed		270 mph
Maximum time		44 hr
Max range		1,500 mi
Speed		270 mph
Maximum time		6.5 hr
No occupants (crew and passengers), 180 lb baggage, 324 gal fuel		
Range		1,047 mi
Speed		270 mph
Maximum time		44 hr
Max range		1,470 mi
Speed		270 mph
Maximum time		6.6 hr

Note: Performance data is computed at gross takeoff weight of 9,900 lb, with the aircraft equipped for all weather instrument flight operations. Range includes taxi, climb to altitude and 45-min reserve fuel allowance.

level to 16,000 ft. Automatic pressure controls operate automatically. The rate of climb is not adjustable. The pilot can override automatic controls for flexibility in climb or descent.

Air conditioning from type adapt system system, rated at 15 tons, will operate while the airplane is airborne at a maximum altitude of 100,000 ft, heating system providing warmth. System will provide controlled cabin temperature while outside temperatures range from -10F to 109F.

Electrical power is furnished by a nickel-cadmium battery and two alternators with generator output at 200 amp, 30 v. Power system makes the airplane independent of external start-up services. Electrical system will provide landing gear extension and retraction, and flap operation.

Fuel system, with a total capacity of 384 gal, includes 58-gal main tanks in each engine nacelle, plus auxiliary tanks containing 500 gal in each outboard wing panel interconnected to a cell in each wing center section.

## USAF Planning Try At Altitude Record

Los Angeles—USAF is planning an official attempt on the world record for altitude achieved from a ground take-off mark now held by the Soviet Union—following two recent flights which unofficially broke the Russian record.

The official attempt probably will be made only next month by Col. Charles E. (Chuck) Yeager, commander of the Aerospace Flight Research School at Edwards AFB. He will fly a Lockheed NF-104, an F-105 Striketail fitted with a ramjetable static inlet and rocket control jets (AW Aug. 3, p. 116).

The two flights within the last month which unofficially broke the record of 111,890 ft set in 1961 by a Russian pilot also was made in the NF-104, with USAF Maj. Robert W. Smith at the controls. Smith reached 115,600 ft on the first flight and 115,500 ft on the second, according to USAF.

## News Digest

Cessna-Wright X-19 VTOL made its first hover flights last week at the company's Goldsboro, N. C., facility but was delayed when the left landing gear failed on the second landing. Design was confined to the fuselage and engine nacelle area.

Kaman Aircraft is planning to fly its K-2B jet augmented experimental helicopter for the first time this week. The aircraft, a modified UH-1C Sea Sparrow with a General Electric T85 turboprop engine mounted on the right side of the fuselage, will explore helicopter high-speed options under a U. S. Army Transportation Research Command (TRC) contract. Bell Helicopter Co. has been flying a CH-119 modified for the Army with two auxiliary Continental J69-T-9 turboprops since Nov. 14.

Donald W. Douglas, Sr., founder of the Douglas Aircraft Co. and its present board chairman and chief executive officer, will receive the annual Wright Brothers Memorial Trophy Dec. 17 in Washington. The award is administered by National Aeronautics Assn.

Soviet Union and the 22nd in the Cosmos series of scientific satellites was launched Nov. 16, with its orbital elements: apogee, 361 mi; perigee, 128 mi; inclination, 64.1 deg; 56 min and initial period, 98.3 min.

Debris found in the Gulf of Mexico, 48 mi northwest of Key West, was positively identified by the Air Force Nov. 21 as the remains of a USAF Lockheed U-2 reconnaissance aircraft that disappeared the day before, apparently while on an intelligence-gathering mission over Cuba. No trace of the pilot, Capt. Joe C. Hise, Jr., had been located by last week. There was no immediate indication that the U-2 had been fired on.

Martin Co. has received a \$13 million Air Force contract to install electronic sensors in the reconnaissance version of the Boeing C-135. Installation of the sensors will give the aircraft the designation RC-135B. The RC-135A, with less advanced sensors, has been in service about two years.

First test McDonnell-USAF F-4C tactical fighter was delayed at the Tactical Air Command test track at MacDill AFB, Fla. More than 1,000 of the present, 1,600-hour aircraft, a modified version of the Navy's F-4B, will be delivered to Air Force during the next five years under a contract valued at about \$7 billion.

# Payments Deficit Stirs International Rift

SAS, Alitalia Attack TWA's 'fly U. S.' drive to ease money drain; action by governments seen unlikely.

By L. L. Doty

**Washington**—Growing controversy between foreign flag carriers and the U.S. airlines over the effects of international air transportation on the U.S. balance-of-payments deficit will be allowed to run its course without any government intervention.

The dispute, which has been kept under the surface for the past two years (AW Oct. 7, p. 47), broke into the open last week when Trans World Airlines President Charles C. Tillgham, Jr. urged American travelers to use U.S. airlines in international travel to help stop the "dollar drain." The plea, outlined in a printed pamphlet, promptly evoked charges of "chauvinism," "imperialism," and "protectionism" from the heads of Scandinavian Airlines System, Inc. (SAS) and Alitalia in separate speeches on the U.S. West Coast.

Both SAS President Tove H. Nifset and Alberto Sciascia, general manager of Alitalia, devalued major portions of their addresses to attacking the flying last campaign.

The TWA pamphlet bluntly declared U.S. carriers are superior to foreign flag airlines, adding that the "golden rule for choosing U.S. airlines" are based on experienced U.S. trained men, superior U.S. jet aircraft and precision maintenance. It added that "now we must add the newest prime line defense of the U.S. dollar."

## Clear-Cut Issues

Government intervention in the North Atlantic flag issue (AW Nov. 9, p. 41) was possible because the issues at stake—clear-cut differences in the balance-of-payments problem is hard, for these reasons: the issues are tangible with political repercussions, straightforward adjustments of the payments deficit can be made, and the effects on international trade, and the State Dept. is finding it virtually impossible to assist the flag impact of air transportation on the automobile U.S. service to position.

The issue here, on which TWA stands its case, is simple: "There is a U.S. balance-of-payments deficit in international air travel. If this was wiped out, the deficit on U.S. balance of payments in the total transportation account would be sharply reduced. If not eliminated."

But there are other factors which, when viewed in their long-range aspects, cause the State Dept. to hesitate in manufacturing a policy and are used by the foreign airlines in their arguments.

To begin with, the amount paid for cargo flag carriers for transportation by

U.S. carriers in 1962 was \$362 million—a relatively small amount when compared to the \$1.3 billion paid by U.S. carriers in 1962 to foreign airlines for air carrier in every category of cargo and shipping.

The \$206 million amounts to only 8% of U.S. expenditures abroad for goods and services.

In the same year, U.S. airlines earned \$126 million from passenger air fares collected in foreign countries. This gives the U.S. a \$214 million unfavorable balance of trade for air transportation in 1962, according to Commerce Dept. statistics.

In developing the transportation account, Commerce Dept. includes port expenditures, which cover such costs as fuel, loading, fees, maintenance, aircraft and air traffic. In 1962, the U.S. received \$190 million from foreign carriers for port expenditures, while the U.S. paid out \$197 million abroad for

these services, to reduce the payments deficit further.

Commerce Dept. holds that the port expenditures mean a "balancing factor" in the payments problem. The department said:

"A large imbalance in the transportation account is unlikely because of the countervailing effect of port expenditures resulting when either U.S. or foreign operation incurs these charges. U.S. carriers receive relative to the other. As U.S. payments to foreign carriers for the transport of U.S. exports and passenger services, the port costs of these carriers in the U.S. must also receive these charges are directly related to the measured activity of the carriers in the U.S."

## Sees Favor U. S.

Air freight also is becoming a significant element in the balance of payments. U.S. airlines carried \$36 million in 1962, and \$38 million in 1963, on the transportation of U.S. exports. Air freight payments to foreign airlines for shipment of U.S. imports amounted to \$24 million in 1962, resulting in a \$14 million trade surplus.

Recent news in favor of the U.S. comes from the purchase of flight equipment. According to Seelye, this would tend to support the U.S. \$500 flight orders to balance the price of part out of Alitalia's Douglas DC-8 jet transports. Nifset said SAS had spent more money in the U.S. than in total sales outside since service began on the North Atlantic.

U.S. carriers argue that foreign purchase of U.S. equipment is not related to the air transport balance of payments problem. However, it is known that one of the issues behind the U.S. decision to proceed quickly with development of a supersonic transport was to protect the nation against a large deficit in the payments balance that might be created by the purchase of the British-French Concorde by U.S. airlines.

It is interesting to note that TWA placed an order for four Concordes (AW Nov. 16, p. 18) at about the same time the "dollar drain" pamphlet was released.

President Kennedy is eager to stop payments deficits wherever possible, and will cut even the smallest dollar flow abroad as air carriers have expenditures from international services in the U.S. abroad. As a result, the Administration is not likely to take a stand on the airline controversy, even though inter-

national relations may become strained, as they did in the few months.

Earlier this year, Congress launched a "fly U. S. Now" campaign aimed at directing U.S. travelers from Europe to their own carriers. This plan was devised to help correct the balance-of-payments problem, but was quickly shelved when the total effect of the plan on international trade was fully understood.

The "fly U. S. A." plan is designed to draw European travelers to the U. S., but has been widely interpreted as part of the "fly U. S. Now" campaign. Last week, Stuart C. Tyson, president of the Air Transport Aux., attempted to dispel this misunderstanding by stressing the need of generating economic traffic, and suggesting, too, that only 38% of U.S. travelers flying international carriers are on pleasure trips.

The chief problem created by the TWA campaign, according to a number of airline officials here, is that in view of the "fly U. S. A." program, travelers could be diverted, not necessarily from foreign flag carriers to U.S. international airlines, but from both these groups to domestic airlines.

In addition, the campaign is considered by some here as short-sighted, as it is not intended to be a long-term solution. It is argued that a travel stimulus is developed, especially in the European Common Market countries, a source that will be difficult for U.S. airlines to tap if the theme of international air transport continues in permanent form.

Military expenditures abroad account for a major portion of the U.S. expenditures abroad, but U.S. business interests also have an important effect on the current deficit. For example, direct foreign investment by U.S. companies abroad now total about \$36 billion, and constant business acquisitions that the profits and services including air travel, offered by the locations in which the investments are held be used to the greatest degree possible by the investors.

According to the Commerce Dept., increased competition by foreign airlines as well as U.S. airlines in the experience of international travel by U.S. residents as a factor in the growth of air payments abroad.

But under the principle of reciprocity as established in transportation, there is no way that this competition can be avoided. In fact, the White House policy on international air transportation (AW Apr. 25, p. 14) discourages any attempts to restrict foreign competition.

In addition, the working group that developed the policy felt that the balance-of-payments problem should not be allowed to influence any U.S. policy on trade routes.

## Slattery, Smallpiece Resign BOAC Posts

**London**—Sir Matthew Slattery, chairman of British Overseas Airways Corp., and Sir David Smallpiece, managing director, resigned last week on the eve of publication of a government White Paper on BOAC's losses and future.

At the same time, Anthony H. Miffland, now chief executive British European Airways, was named to succeed Lord Douglas of Kilmuir, B.E.A.'s chairman, upon his retirement next week. Both BOAC posts will be taken by Sir G. G. Gifford, a director of the merchant banking firm of Brown and Steiner, and a B.E.A. director Miffland will take a seat on the BOAC board.

Resign of the government to write off BOAC's \$224-million accumulated deficit was expected in the immediate case of the two resignations.

Also a source of features has been a recent report from John Collier, a private economist, in *Members of Aviation* John Slattery—the party became the boss of the White Paper. Nathan Korman on B.E.A. was said that the Collier report contained, and both have complained that they have been based on day-by-day planning as a rule.

Slattery's term of office was to run until July. When Slattery told him that his account had been selected, Slattery said he asked that the change be made at once. Slattery told the House of Commons that Gifford planned to name some functions of the managing director and that Smallpiece had agreed to resign to facilitate the move.

Both points at the BOAC White Paper.

BOAC and Smallpiece in a commercial understanding.

Government proposes to strengthen the airport's management.

Government has decided upon any merger with B.E.A.

New chairman must prepare within 12 months, a plan for making BOAC financially sound.

## TWA's Hall Selected to Succeed MacIntyre as Eastern's President

**New York**—Morton A. MacIntyre will leave his post as president and chief executive officer of Eastern Air Lines on Dec. 15, and will be replaced by Floyd D. Hall of Brown World Airlines.

MacIntyre later "personal reasons" as the basis for his resignation, which was accepted by Capt. E. V. Rickenbacker, chairman of the board.

MacIntyre, who was president of TWA, will also be MacIntyre's successor in the Eastern board.

Eastern appointed George S. Gordon as vice president and managing director.

TWA will also be replaced by Raymond M. Dunn, vice president of technical services who directs the aircraft maintenance program at New York City's overhead base. Dunn will also be TWA's technical director.

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1959, was in the legal profession. He said at that time that "I'll know about the airline business in that you'll have your seat and your wings and your capsule when the light goes on." Hall, a 24-year employee of TWA, began his career as a pilot and rose to executive status through the operation route.

Questions—the day-by-day business of the airline—was one in which many within Eastern had the career has achieved lesser attention during MacIntyre's administration. It is generally considered that Hall's experience in the law influenced the decision to offer him the position.

Eastern, admittedly, has encountered problems in recent years that would be difficult for anyone to master. From 1958 to 1963, Eastern's operating cost losses, which totaled \$12,500,000 in the first nine months of 1963 alone.

Since MacIntyre took office, company losses from National Airlines and North American Airlines have increased in Eastern's gross New York market rate. As an unsuccessful bid to influence the Civil Aeronautics Board to approve a merger with American Airlines, Eastern created a reputation of being hard-headed and inflexible.

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## FAA, CAB Funding

**Washington**—Senate last week passed the \$40 million appropriation requested by the Administration for research and development on the supersonic transport and increased federal subsidies for helicopter service in New York and Los Angeles to a total of \$5 million.

An amendment by Sen. William Proxmire (D-Wis.) to increase the \$40 million from the Federal Aviation Agency's fiscal 1964 budget was defeated, 72-7. The Senate voted \$18.4 million for the Civil Aeronautics Board and a total of \$77.9 million for FAA.

upheld in one of MacLachlan's major achievements. But even that innovation, despite some public acceptance, has not been adopted by the FAA. Eastern's route (the airline, members of the board admitted, wanted it) the shuttle a producing enough revenue to justify the cost effort involved in running it. Some feel that Eastern's long-range service has suffered due to too much emphasis on the shuttle and its allied within service such as that between New Orleans and Houston.

Principal drawback to the shuttle has been the guarantee of a seat. This has required extensive ferrying at times during peak load periods and the mistiming of on-duty crews to fit extra sections. The within service also has

been responsible, and more so as it study under way at Eastern to eliminate it. The space is frequently required within the shuttle, but the shuttle service has should have been higher at the beginning, possibly \$10-15.

Although Eastern has had problems, the difficulties aren't viewed as long-term problems, different from those encountered by all airlines in recent years. But Eastern is still losing money while most other domestic carriers are reporting profits. Feeling a victim within Eastern that is partially due to its excessive involvement at the expense of competitive service.

Hill is credited at TWA with attaching a good return on money spent to run the airline. When he took office,

advertising budgets were expanded and passenger service was directed up to include long-haul and even night service. TWA has expanded its management team, particularly in finance and market research. And TWA is making a profit today, which it wasn't doing when Hill took office.

Medley, who is 55 years old, was earning \$83,800 a year as Eastern's. He said his future plans are open, and denied reports that he would return to his former job in Erie, Delaware, Philadelphia and McGraw-Hill in New York.

Although Hill's salary at Eastern was not disclosed, reports indicate he will receive more than Medley's, possibly in the area of \$100,000 a year on a five-year contract.

because of the delivery schedule since it has not yet ordered. If it did it would be required to position 38 or further back on the production line in a delivery contract. For American, a large competitor of United in the West Coast flight market, could use the aircraft on the route. United, in a domestic carrier, would not order more than the 22 deliveries per position under consideration as a U.S. flag in the Pacific, according to FAA.

Spokane for United contract that is under separate transport before FAA affect aircraft and engine manufacturers is possible. They hold that FAA will not act on an overriding attitude in its private schedule and period that will be sufficient time to buy for delivery of the aircraft later.

In exploring the delivery policy, Runyon's noted that the schedule should remain "flexible," pointing out that factors such as selling early down payments could change the schedule at it did with American. Detailed agreements covering the schedule will be worked out between FAA and the airlines in the future, and the delivery program need not be completed. Annual orders are tentative and subject to change, he said.

In cases where down payments are not made, rejected payments will be subject to actions that have made delays.

Prior to Nov. 1, 1965 aircraft can withdraw from the program and have deposits refunded if the supervisor design fails to meet the requirements. On this date, a second \$100,000 deposit per aircraft will be required. Delivery penalties for those aircraft will be cancelled and money refunded if they fail to meet the additional program. Because of the delivery schedule, the airlines the government terminates the domestic transport program. FAA said.

In May 1, 1966, aircraft manufacturers and airlines on the points that are expected to complete contracts by this date will permit the manufacturers to cancel the airline's previously reserved delivery positions.

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## Allied Pilots, American Sign BAC 111 Pact

New York-Alled Pilots Association signed an agreement with American Airlines last week to fly the carrier's BAC 111 BAC 111 flights to a pilot crew.

The American pilot, effective when BAC 111 deliveries to American begin in 1967, will fly the carrier's BAC 111 flights to a pilot crew. The pilot crew will receive \$2,075 per month. Capitan will receive \$2,075 per month. Capitan will receive \$2,075 per month. Capitan will receive \$2,075 per month.

## Allison Turboprops to Be Installed On Four Frontier Airlines Convoys

New York-Installation of Allison 501-D13 turboprop engines is scheduled for the first of Frontier Airlines' Convoy 140 transports.

The 53,200-hour convoy will increase the 340's speed by 100 mph and raise the allowable gross weight from 47,000 to 52,000 lb. Passenger capacity will be increased from 46 to 52 seats. Landing gear axle loads at about the same level as that of the existing transport Convoy.

Since the weight of the Allison engine is 3,770, compared with 2,400 lb. for the Pratt & Whitney C88 turboprop engine now on the aircraft. The increased power will triple the 340's rate of climb. This is an important factor in Frontier's operations. The new engine will triple the maximum cruise altitude is often 86,000 ft. above sea level. The increased speed is also an asset, since Frontier's route stage length is the longest of any local service operator.

Frontier has taken an option with Allison for converting 14 more 340s to turboprop power. This would involve the purchase of 14 more aircraft. The airline presently operates 14 Convoy and 18 DC-9s.

The initial order placed by the airline is for eight engines on the aircraft and three spares.

The convoy is being financed through a loan from the Bank of New York. Pacific Airline, Burbank, Calif., will install the engines beginning Jan. 6. Approximately 90 days per aircraft is needed for the work. The first turboprop 340 should also be installed under the same Allison Division of the General Motors Corp. will provide overhaul service.

Frontier is seeking the Federal Aviation Agency for a 2,000-hr. inspection-overhaul (TRO) on the 501-D13. The repair has been done on Convoy

convoys for four years, accumulating 51,812 hr. through last September. The contract, awarded last June, by the FAA has five, General Motors Air Transport Service has more, and the rest are in executive service with various companies.

The airline earlier considered the Napier engine for a convoy such as that used by Allegheny Airlines. However, problems arose that prevented the TBO on the Napier engine from a convoy. The engine, which has been overhauled in its own facility, then turned to Allison. But Allison's decision to buy the engine until improvements were made in the gear box and turbine assemblies.

## Canadian DC-9 Delay Raises Political Issue

Ottawa-Delays by the Canadian government in setting up a memorandum of understanding between the airline and the Canadian government have delayed the delivery of the DC-9 aircraft to the airline. The airline has been delayed in the delivery of the DC-9 aircraft to the airline.

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A major factor in the DC-9 decision was the fact that it could not be used in the DC-9 decision was the fact that it could not be used in the DC-9 decision was the fact that it could not be used.

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## U.S. Flag Carriers Receive SST Priority

By Robert H. Cook

Washington-U.S. Atlantic flag carriers were given top priority in the supersonic transport delivery schedule outlined by the Federal Aviation Agency in a policy statement last week covering the first 70 supersonic transports to be produced in this country.

The delivery policy, issued by ANTIWORLD and SPACE TECHNOLOGY (Nov. 4, p. 45), gives second priority to foreign Atlantic carriers, third priority to U.S. Pacific carriers, and fourth priority to foreign Pacific carriers and U.S. domestic carriers, with the exception of American Airlines, are allotted last priority.

The delivery policy follows a battle between Trans World Airlines and Pan American World Airways over which company will receive the first supersonic transport. The policy is based on the assumption that airlines will order 500,000 down payments by next May to secure delivery options.

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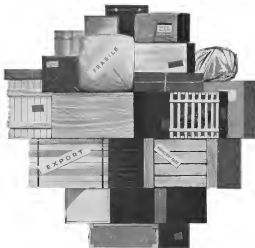
for TWA and Pan American, the agency feels it is justified in making a comparison to the delivery schedule which otherwise would have been for domestic use until production amount 38—about two years after the first aircraft are scheduled service.

Although, the first foreign carrier to order the U.S. aircraft will get the 50th aircraft produced.

Japan Air Lines, the first foreign carrier to order for Pacific service, will receive the 10th aircraft.

FAA has spelled out these tentative delivery positions—assuming others for the carriers which have placed orders:

- Trans World Airlines—1-6-11-13-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-100-101-102-103-104-105-106-107-108-109-110-111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000-1001-1002-1003-1004-1005-1006-1007-1008-1009-1010-1011-1012-1013-1014-1015-1016-1017-1018-1019-1020-1021-1022-1023-1024-1025-1026-1027-1028-1029-1030-1031-1032-1033-1034-1035-1036-1037-1038-1039-1040-1041-1042-1043-1044-1045-1046-1047-1048-1049-1050-1051-1052-1053-1054-1055-1056-1057-1058-1059-1060-1061-1062-1063-1064-1065-1066-1067-1068-1069-1070-1071-1072-1073-1074-1075-1076-1077-1078-1079-1080-1081-1082-1083-1084-1085-1086-1087-1088-1089-1090-1091-1092-1093-1094-1095-1096-1097-1098-1099-1100-1101-1102-1103-1104-1105-1106-1107-1108-1109-1110-1111-1112-1113-1114-1115-1116-1117-1118-1119-1120-1121-1122-1123-1124-1125-1126-1127-1128-1129-1130-1131-1132-1133-1134-1135-1136-1137-1138-1139-1140-1141-1142-1143-1144-1145-1146-1147-1148-1149-1150-1151-1152-1153-1154-1155-1156-1157-1158-1159-1160-1161-1162-1163-1164-1165-1166-1167-1168-1169-1170-1171-1172-1173-1174-1175-1176-1177-1178-1179-1180-1181-1182-1183-1184-1185-1186-1187-1188-1189-1190-1191-1192-1193-1194-1195-1196-1197-1198-1199-1200-1201-1202-1203-1204-1205-1206-1207-1208-1209-1210-1211-1212-1213-1214-1215-1216-1217-1218-1219-1220-1221-1222-1223-1224-1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# Financial Woes, Internal Strife Face KLM

By Cecil Brewster

**Crisis—KLM Royal Dutch Airlines** is striving to overcome a management crisis plus a resultant split within its work force that already is threatening the carrier with additional financial problems and possible direct government intervention.

Most immediate source of friction is the airline's disputed decision that between 200 and 250 of its present force of 770 pilots must be laid off within the next future for financial and operational reasons.

Thus, combined with the appointment of an outside personnel director who will rule on the demands and the amount of compensation received, has led the KLM pilots union to announce that it has "no confidence" in the airline's new four-man management structure which came into being last January following the resignation of President E. H. van der Beek (AW Jan 31, p. 41).

The "no confidence" motion, which resulted as threat of a strike attempt, also stemmed in part from the general knowledge that at least one of the five directors, E. H. Larve, was fighting against some of the proposals for a general reorganization of the carrier's operational structure recommended by McKinsey and Co., Inc., a New York management consulting firm, after a prolonged study last year of the carrier's overall operation.

Larve also has hinted that he would trim the number of proposed pilot dismissals, a figure contained in the McKinsey report and one which has the backing of the other three managers. A KLM spokesman said last week, however, that these now is "only in the top management," although he conceded that "this doesn't mean that we still don't have our differences, but when a majority decision is made, it can be carried out."

The earlier plan to reduce between 200 and 250 pilots still remains in force.

Whether or unity has been attained by the management—and, admittedly, it is a tenuous one—has been questioned by incidents efforts plus indications that the government is prepared to step actively into the fray if the dispute continues unabated.

The chief mediator is A. H. C. Gies, secretary general of the Ministry of Transport and the government's fiscal representative on the KLM board of directors. Gies has a long record of mediation. Gies, a wing leader of the Dutch Minister of Transport Johannes van Aartsen, who has told parliament that he would be forced to take additional steps unless harmony is quickly restored both with management and in the inherent relations with the pilot organization.

One possible contingency question, a government spokesman told Aviation Week & Space Technology last week, might be to call a stockholders' meeting to consider the McKinsey proposals and management opinion towards them.

At this juncture is the airline, there is little doubt that the government would have its way at any such session. The government generally favors the approach taken by Larve's approach in the internal struggle.

A new personnel director was named despite Larve's opposition and, according to one official, the KLM pilots fear that he will be "too severe" in ruling upon the amount of compensation each discharged employee is to receive.

KLM officials depict that this is a true and point out that a selective general compensation plan has been worked out for about pilots who retire before Dec. 31 that they are willing to accept voluntarily. An individual pilot under this plan can receive up to \$19,000.

"We know it will be difficult for them," one KLM spokesman said.

### BEA Records Profit

**London-Edinburgh Express Airways** achieved a \$12-million profit in last month from last April to October, Lord Douglas of Burda said last week. The figure was reached after paying interest on all capital.

The state-owned airline lost money in the last fiscal year, but has budgeted for a profit of \$4.2 million at the end of the fiscal year (AW Sept 2, p. 16). A profit was made in each of seven months since last June in three years.

During the seven month period, BEA offered 6 million seats and flew 4 million passengers. In addition, the airline carried 32,000 tons of freight and 7,000 tons of mail.

The airline last week placed an order worth \$7 million with Gecor Company Ltd. of Rome for a fleet of six subsonic electronic unit avionics system. The system consists of two Electric 400 central processors, six computer memory units, six computer memory units. Delivery will be in mid-1966.

"They have been trained as pilots, and there aren't many competent pilots who open to them in Europe, so most of them will have to learn a new position." We want to be fair with them." Corporation for those who are dismissed after Dec. 31 is still an air issue.

Aside from the differences within the management, another difficulty that must be overcome is the split within the work force itself. The ground crew, flight engineers, ground and overseas trade unions reportedly have lined up almost solidly against the pilots.

"What we have to avoid is a real split that could hurt us," one KLM spokesman said. "It's because a psychological thing. Different builds up and it's hard to stop."

The psychological factor also is playing a major role in the additional financial strain being levied upon the airline by entering an uncertainty as to its status on the part of potential passengers who, KLM fears, may now be looking elsewhere for reservations. In the worst scenario, greatest losses could come from airers decline in transatlantic charter business.

Ironically, the airline, which has suffered severe financial losses over the past two years, reported last week that the tide may be turning at least temporarily. For the third quarter of the year, the KLM recorded a profit of approximately \$4.4 million, and a KLM spokesman said October also was "very pleasant."

The airline's financial leaders over the past few years, which have consumed huge doses of government aid, have been a variety of nations including the United States in an attempt to save the carrier, the generally disastrous year of 1963, a doubling of traffic, particularly on the Pacific routes in the Netherlands' colonial empire was achieved over. Gies has planned a series of potentially profitable routes and a prolonged determination to eliminate others that had become uneconomical money losses.

Two prime reasons for trimming the pilot force are planned reduction of costs of the carrier's service and the accumulated situation in an airline's first year during Douglas DC-6 jet transport to most overseas ports and Vickers Viscount and Lockheed Electra turboprop aircraft within Europe.

KLM also hopes to place an order before the end of the year for a transoceanic medium-size jet transport—probably the Douglas DC-9 or the British Aircraft Corp's BAC 111. In fact, there were, another source of pilot stress probably will be made.

## AIRLINE OBSERVER

►U. S. domestic airline passenger business continued to rise sharply in October when revenue passenger miles increased 19% over the volume handled in the same month last year. Chances are now strong that a 12% increase in revenue passenger miles will be reported for the year. Available unit rates in October were held to a 10% increase, to ease the industry load factor to 53.3%, a 4% increase over the load factor in October, 1962. At the present traffic growth rate, average passenger miles will pass the 40-billion mark in 1963 for the first time.

►Load sensor carriers also showed similar gains in October, with a 10.6% increase in revenue passenger miles over the same period last year. Available unit rates rose only 5% to achieve the load factor of the 11 carriers to 46.1%, a 4.4% increase over October, 1962.

►Plans to use the standard Vickers VC10 jet transport between London and Montreal early next year have been dropped by British Overseas Airways Corp. (AW Aug. 1, p. 40). Instead, VC10 service to North America will start in 1965 when the Super VC10 enters service. A company official said the standard VC10 has been directed to Persian Gulf service, which is scheduled to begin next year. VC10 was earmarked for Canada, he said, only because at the time of the decision, BOAC had no Boeing 703s available for this operation and the VC10 would have provided extra capacity needed. Another factor is that the standard version was loosely designed for hot country operations. In addition to the Persian Gulf, America and the Far East will be served by the VC10.

►Chances are strong that Pakistan may ask British again for landing rights at Hong Kong to permit operations from Karachi to Tokyo (AW Nov. 18, p. 45). Existing agreement between Japan and Pakistan provides for landing rights at Tokyo on flights operating through Hong Kong. But when Pakistan was denied rights at Hong Kong by Britain, it signed an agreement with Red China for landing rights at Canton and Peking. Japan refused to amend its agreement with Pakistan in possible for the routing through China. Britain reportedly barred Pakistan entry into Hong Kong for purely economic reasons.

►Swire has signed an agreement with Ghana Airways Corp. whereby Swire will operate two flights weekly between Accra and London with Caravelle 330 transports carrying Ghana passengers and cargo. Plans will allow Swire registration and will be financed by Swire flight crew and cabin attendants. Ghana pilots, ground and baggage will be aboard in seven or ten times.

►Eastern Air Lines has canceled over four million passengers on its Washington-New York-Boston Air Shuttle operation since the service was inaugurated in June, 1960. In the first nine months of 1963, two million people were flown, and it is estimated that almost three million passengers are using the service annually. Single-day all-time high was on Nov. 8 when 14,308 passengers boarded the Air Shuttle.

►Pan American World Airways has been granted permission by the Federal Aviation Agency to operate Boeing 707-120 transports on scheduled thrice-daily service with 187 passengers. Airline regularly requested 184 seats but an experiment test demonstrated that two seats adjacent to the emergency exits should be removed. Pan test required 7 rows, 21 seats to evacuate 185 people and seven crew members, saving 18 seats from 17 to 56 seats. Second test, with 187 passengers and seven crew members, required 56 seats for evacuation. Crew exits on one side of the plane were used in order to simulate the system of an accident.

►Acroft has introduced the broadest winter passenger tariff discounts in its history, despite warning by the Roman carrier's competitors that low rates are getting out of hand. New tariffs include 50% discounts for students riding Tu-104s, Tu-124s, Tu-134s, Il-18s, An-10s and An-26s between Nov. 10 and June 15. During the same period, tourists flying in groups of 15 or more will receive a 20% fare discount.

## SHORTLINES

►American Society of Travel Agents has proposed that governments purchase and stockpile expensive time parts and allow their flag carriers to purchase the aircraft as needed as a means of preventing the same overcapacity problem caused by the introduction of subsonic jets.

►Boeing 727 jet transport has returned from a world demonstration tour that took it to 36 cities in 36 months, logging more than 70,000 mi. and 137 h. 13 mg. time.

►British Overseas Airways Corp. has suspended direct London-Los Angeles polar route service and will concentrate its sales effort on the London-New York-San Francisco connection during the next two years while the New York World's Fair is in progress.

►Civil Aeronautics Board has approved fast, second- and third-class jet fares between New York and San Juan, Puerto Rico and between Miami and Puerto Rico. Third-class fares on propeller aircraft between New York and San Juan also were approved but the Board held that Eastern's third-class propeller fare between Miami and San Juan should be dropped from \$53 to \$39.95.

►Civil Aeronautics Board last week ordered a "use-it-or-lose-it" investigation of certain route segments of Lufthansa Airlines. This is the 15th such proceeding the CAB has initiated.

►Peking Tiger Line has reported six-flight increases of 51.4 million for October, an increase of 10% over the same month last year.

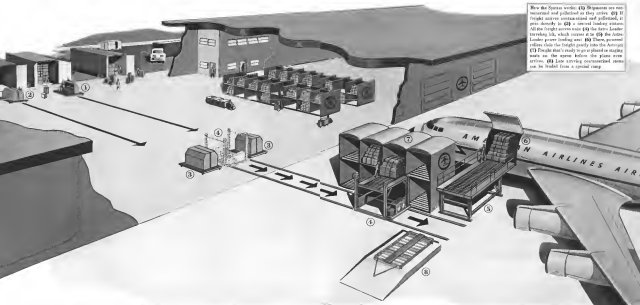
►Korean Airways has resumed flights between Korea and Baghdad. Original service between the two points was dropped three years ago.

►Minnesota Mining and Manufacturing Co. has purchased two Fairchild F-27 transports for executive use.

►National Airlines has increased its advertising budget for the current fiscal year to \$4.5 million, a \$3-million increase over last year's expenditure for advertising and promotion.

►United Air Lines has placed an order with Hamilton Co. for the purchase of 51,250,000 worth of seats for expansion of its single-class service to the Boeing 727 jet transport. Initial order for the five closest seats, when single-class service was introduced on the Boeing 720 fleet, totaled \$2.5 million.

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## Pilots Group Maps SST Operations Policy

By Herbert J. Coleman

London-Airline pilots from 10 countries warned last week that development of a supersonic transport should include their views on safe operations and set next March for completion, at Manila, of a major policy statement covering these attitudes.

In effect the pilots took the same "showers" issued demonstrated last year at Amsterdam's blind landing system meetings (AW Nov. 5, 1962, p. 47) during the four-day symposium here of the International Federation of Airline Pilots' Assoc. Key points:

- **Any attempt to introduce SST** aircraft on a commercial basis before these problems have been resolved to the satisfaction of IALPA, should be resisted by the federation and its pilots.
- **Airplane must be compatible** with other traffic, including those in the subsonic regime.
- **Continuation of SST** aircraft should be at the same level of safety as other aircraft being considered by the same authorities at the same time. Pilots fear that attempts will be made to reduce standards for such items as pilot field of vision, fuel reserves or vertical landing gear loads at supersonic heights.
- **Airplane must be designed** so that in all foreseeable emergencies, chances for survival of passengers and cabin attendants must be better than the same in the equivalent of those intended for operating crew members. The federation will oppose any attempt to require passengers from crew by pressure difficulties. It is against providing crew members with special equipment which, in an accident resulting in passengers and cabin attendants being killed or seriously injured, would protect operating crew members. In addition, the federation and structural reliability of passenger area must be assessed since the possibility of rapid decompression in flight cannot be ruled out.
- **In the area of SST noise**, the federation has contended the airplane must not be such a nuisance to the public that the pilot in command is prevented from operating according to optimum procedures. This is a reference to further restrictions on night operations for noise abatement.

The federation, as shown trends in the field of licensing and pilot testing now, claimed that an attempt may be made to prevent some airline pilots from flying civil SSTs because of age or physical and education characteristics. Federation members will strongly resist introduction by any authority of a special type of licensing or testing for SST operations. They held that a pilot, if qualified, if qualified, be permitted to add an other type permit, including SST, to his current license.

- **Another problem** is that of crew health, particularly in the area of fatigue and other upper atmospheric phenomena. IALPA and that until further evidence is available it will regard the maximum permissible whole-body dose and dissipation accompanied by the international commission on radiological protection as the highest allowable for aviation pilots.
- **Flight planning.** The federation and that prior to certification beyond subsonic speeds, details of time, height and location at which the aircraft is due to reach its subsonic speeds must be known in advance to the pilot in command. During the negotiation, pilots expressed alarm that the necessary precision instrumentation for planning flight systems does not yet exist, in view of a 1 hr of working time in the air.
- **Control and handling.** Since SST should be controlled in descent by the pilot in the cockpit throughout the entire approach and descent, no foreseeable emergency. Physical demands of flight decks must permit performance of preflight, navigation, communication and various emergency procedures. A fear that, in the search for greater aerodynamic efficiency, the trend in the industry to

ward cockpit which are too small. • **Navigation aids.** Each aircraft should be equipped with a proven, in instances, self-driving navigation system so that both pilot and ground controller know the attributable location in message and subsequent flight. It was implied that actions involved possible ground personnel trained properly for supersonic flight planning on the theory that the equipment is of no use unless properly trained.

After then what is now considered official IALPA policy on supersonic transport, a considerable work program is being carried out by various countries for support in the Manila meeting.

For example, if a variable geometry wing is adopted for the U.S. supersonic transport, the federation will require that guidelines of possible accidents be designed out of the aircraft in full-scale techniques. It wants the opportunity to be substantiated demonstrated by means before operation in the field of variable geometry aircraft and exhaust tests as those now under development by the Anglo-French Concorde and its British Siddeley Olympus 905 propellers (AW June 10, p. 51).

Another factor in flight controls. The federation will require that automatic vision systems, such as yaw and pitch detectors, be designed and tested full scale, if any such failure would worsen the SST's handling characteristics. It also notes of flight controls such as manual elevators are considered, the federation has already been in contact with the pilot group involved-ALPA in the U.S., for example. "Without

### Subsonic Jets Near Technical Peak

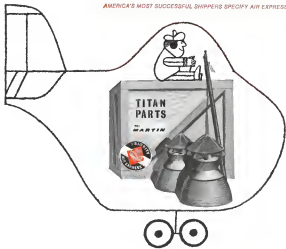
London-Research and development is not likely to lead to such that subsonic improvements in subsonic jets as engines, aerodynamics or structural efficiency—according to Dr. A. P. Russell, British designer of the Anglo-French Concorde supersonic transport.

Addressing a joint meeting of the Society of British Aircraft Constructors and Association International des Constructeurs de l'Aéronautique (AIDCA) at London, Dr. Russell explained:

"Certain work has been done for boundary layer control to reduce noise. Surely in a highly competitive field as aviation, someone is sure someone would, by now have developed a solution and offered it in some portable form. The probability is that no solution exists."

Russell concluded that the scope of improvements in subsonic aircraft is running dry. "At first it was in low operating costs are concerned... the facts are that the best types of control surfaces are safe, comfortable, reliable and accurately built. They are, however, at any time due to their gradual technical improvement."

He acknowledged that supersonic transport will be more expensive. But he said that with the study that now made possible, improved boundary layer operations and lower aircraft noise cost, "they offer the best chance in the long run of providing the most efficient mode of transportation as long as long international routes."



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adopted by manufacturers should be demonstrated to pilots before introduction into service.

Fuel control and systems were a major concern to pilots during the symposium. A special committee will study various parameters, such as fuel temperature within the tanks, thermal degradation of fuel, and fuel balance. A special group will concentrate on ground handling and airport facilities, both loading and unloading.

In the area of general loading conditions, the federation is considering a requirement that, because of possible incidence of high g loadings caused by turbulence or intentional instability, a safety harness or some other protection should be provided for all occupants of the aircraft.

The symposium was planned for 150 delegates but attendance swelled to more than 450. It was opened by the Duke of Edinburgh—himself a licensed pilot—who stressed that an idea of introducing special firing techniques for spaceborne transport to overcome noise, or in fact commercial requirements, should be abandoned.

"At best they lead to only one difference," he said, "and at the worst they can be very definite hazards to safe operation. Either the airplane is acceptable when operated in the way that way or it isn't. I see no point in compromising with safety."

The Duke agreed that pilots should be in an SST development from the start but added:

"Apparently this view is not universally held. For instance, there is no representative of active airline pilots on the government committee dealing with the Concorde project."

Another speaker was British Minister of Aviation John Austen, who stressed the present difficulties of design and construction of the Concorde but advised its "irreversible" acquisition of intelligence and manpower to solve them.

Austen said he hoped that British Overseas Airways Corp. and Air France would be the first operators of the Concorde, although neither has indicated its needs as yet. Austen noted the airplane was off to a good commercial start with its foreign orders. IAW New York, p. 39) and added as an aside that if any of the airlines "unconsciously" caused their airlines, they will hasten to the money put down for planes on the production line.

Discussing the design philosophy of the BAC-Sud Concorde, Pierre Siret, technical director of Sud Aviation, recalled that initial studies were needed at a delta wing with a fuselage, because of the large lift obtained. Low-speed landing problems produced by this shape forced the team to abandon that direction. Siret said, for example,

at large angles of attack a curved surface forward of the main wing, pin attached to the fuselage, can generate high flow around the other aircraft components.

"In particular," he continued, "the lift is greatly affected by the interaction of the curved surface."

Turning to a delta without a curved surface, Siret said it has proved necessary to alter the planform shape, even no longer a true delta shape, meet the wing leading edge curved toward the root, thus giving an increased sweepback, and the wing tips were rounded. This resulted in the so-called "Coffin" wing. Siret said it was also responsible for the fact that the wing had to be given appropriate camber and twist, particularly in order to reduce bending drag. That problem was solved by the Concorde's provision of fuel transfer.

He said it was finally decided to provide a nose which also had variable geometry, meeting two requirements:

• No nose, low drag and adequate visibility.

• Visibility on takeoff, during approach and in landing. Siret's comment could have been a reference to a new nose mockup now under construction at British Aircraft Corp.'s Bristol factory at Filton (IAW Oct. 28, p. 35), which BAC refused to discuss.

Siret said the variable geometry wing was dropped because of the cost of construction and maintenance. He said the absence of wing flaps was justified because of high thrust on takeoff, low wing loading on landing, and the "acceptable aerodynamic characteristics of the wing at low speed." He explained:

"The wing benefits a lot from natural additional lift resulting from a new type of flow—the leading edge vortex—which occurs at leading angles of attack, and persists beyond the normal separation limit without any sign of stall." Siret said that investigation showed the increase in lift obtained in this manner is on the order of 30% in relation to that forecast and increased for several reasons.

He added that an extremely favorable ground effect further increased the lift by 60% at the moment of landing gear touchdown. The airplane, he said, will have a high angle of attack in its approach configuration and, consequently, heavy drag will cause effective deceleration as soon as the pilot throttles back.

In supersonic cruise, the lift to drag ratio of the wing is on the order of 7.5 to 8. Normal flow is restored in subsonic cruise, Siret said, due to the type of member chosen, it is then possible to obtain lift to drag ratios on the order of 13 to 14—about five times as an in-cruise subsonic jet aircraft.

Siret also said that the high lift to

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drag ratio enables a high rate of climb-out, thus reducing noise to itself. Because this rate is maintained as true cruise flight, climbout is not required for operations beyond Mach 1. Some said.

"Defined in this way," Sater said, "the aircraft can be considered as remarkably simple. The wing is fitted with no aileron parts, with the obvious exception of the elevator."

The only systems which are at all new, such as the fuel transfer system and the variable air intakes, are relatively simple and will have been widely tested out on numerous aircraft already in service when the Conquest makes its first flight.

The Conquest will include an automatic throttling system tied in with bleed landing system. Both devices now are being tested on the Sud Caravelle at Toulouse.

Shifts of center of gravity when the engine goes from takeoff to cruise mode—in the case of the Conquest, the cg in subsonic flight is about 50% of the mean aerodynamic chord (MAC) and moves back to 60% MAC in supersonic flight—is accomplished by fuel transfer. This is done by using jacking fuel from the forward tanks to a main tank on the rear fuselage.

Safety of the fuel transfer system, Sater said, will be obtained through duplication of controls and transfer pumps, and by making it possible to drain the aftertank fuel return will be a geyser system.

Engine engines, Thomas P. Ford, chief pilot at Bristol Siddeley, and J. P. Little, Chrysler 991 project engineer, told the pilots that the compressive and combustion system will be based on units now in service on Avon Vulcan Mk.2 bombers, but also will use results under development for TSR.2 powerplants.

Then said costs from of the 991 has been increased. Hardware in this form has run for a considerable period on testbed at E440.

Ford and Little said jet pipe may contain a partial afterburning system. This is still a matter of discussion with the French but if the system is fitted it will be a single garnet type with fuel injection integral with the gitter. The system in the jet pipe (temperature obtained in this system will be in the order of 3000°C with additional thrust of about 25% at Mach 1.2.

Use of the afterburner will be limited to short periods during maximum acceleration. The climb phase of flight and control will be at the maximum velocity obtained by a single engine mode.

Speakers added that pilots of the primary mode may be forced to pass through lobes, providing an additional degree of noise abatement of some 5 db at the nose for a small thrust penalty.



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speed (10 ips to 60 ips) electrically switchable electronics and transport. Ampex ES-300 solid state electronics offer Direct recording to 300 KC, FM recording to 20 KC, or IRT compatible PCM. The FR-1200 also features a new tape transport. Rugged and reliable, it offers low flutter, prevents tape stress during test starts, provides constant tape tension on both reels and has new tape braking and guidance systems. For details write: Ampex Corporation, Redwood City, California. Sales and service engineers throughout the world.



Main engine of Apollo escape system burned for 8 sec, with 115,000 lb. of thrust during test launch. Note exhaust of pitch control motor near

base (AW July 21, p. 44). Tower separation (above, center) shows ignition of Thiolon motor. Note command module at left between phases

## Apollo Test Shows Escape Sequence, Chute Deployment

Tests of Apollo escape system at critical altitudes will follow successful first pad abort test at White Sands Missile Range, N. M., Nov. 7 (AW Nov. 11, p. 42). Purpose of the launching was to test operational characteristics and stability of Apollo escape configuration. Apollo boilerplate capsule was fitted beneath its T54 escape tower to a height of 5,100 ft., propelled by solid propellant launch escape motor designed and developed by Lockheed Propulsion Co. A second motor, for pitch control, controls direction of flight. Escape system above the command module is actuated by a Thiolon TE 93 rocket motor. Three Northrup Vredestein main

parachute (below), each 85 ft. in diameter, deployed the empty Apollo capsule 7,600 ft. from the pad. Rate of command module descent was 24 ft./sec., compared with 30 ft./sec. desired for the Mercury capsule. Total flight time was 3 min. 45 sec. Only apparent damage to the spacecraft developed and built by North American Aviation's Space & Information Systems Div., was slight chipping from rocket exhaust. Wreckage about 9,000 lb., the boilerplate command module for the pad abort test assumed 11 ft. 9 in. tail and 12 ft. 30 in. wide. It had a laminated glass heat shield and aluminum honeycomb core, but no ablative material.

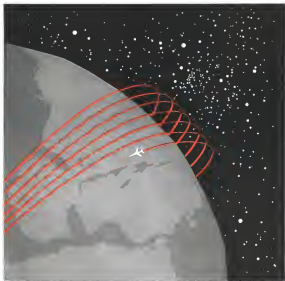


Continuance of rapid sequence photos (left and center, above) made at 10-per-sec. rate, show Northrup Vredestein main chutes in tested condition immediately after extraction, and opening to allow descent of module at 24 ft./sec. rate. A different camera made photo (right, above) of jettisoned escape tower and module descending.



New capsule touchdown, 11-ft. Rogal parachute fully inflated. Apollo boilerplate module (right) is inspected after touchdown.





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# Still Cameras Designed for Lunar Mission

By Ward Wright

New York—U.S. camera manufacturers are proposing designs of still cameras for lunar exploration although the National Aeronautics and Space Administration has not specified a requirement for photographic coverage of the mission.

Unspecified proposals or technical means have been prepared by Goebel, Fairchild and Defense Systems, J. A. Mattern, Inc., Chicago. Aerial techniques and effects who anticipate a NASA need for hand-held or mounted cameras.

Although the initial Apollo mission may be directly credited, manufacturers also are concerned in later space exploration.

No photographic mission has been defined for Apollo. No camera has been allocated or released to industry for studies. A few persons at NASA's Manned Spacecraft Center in Houston are studying what has been submitted so far, but no requests for proposals have been made.

There is concern that as the task for some glassware, Apollo landers are the camera program may be left in the last minutes, as manufacturers have given ahead on their own in the hopes of proving their designs early.

### Camera Categories

Suggestions for a lunar camera fall into two categories.

One approach is to encase an existing camera, probably with necessary modifications, in a sealed container to protect it from the moon's vacuum environment. The camera could be controlled remotely.

The second approach is to design an entirely new camera specifically for lunar photography.

Mattern, whose lunar camera studies have been going since to later have launched missions than in Apollo, believes a fresh design will be needed. Goebel and Defense Systems indicate there is an existing concern with or without professional modifications which often the needed reliability for the Apollo mission. Fairchild has considered both possibilities but says in its memo on the subject, that a camera designed to operate without protection in the lunar environment would provide valuable experience for later manned space missions.

Regardless of what approach these companies feel is best for a lunar still camera, they are in agreement that any camera design will have to consider these environmental factors:

- **Temperature:** Lunar temperature

ranges from about 230°F in the center of the moon's bright side to -160°F on the dark side. A larger lunar camera operating on the moon's bright side might suffer structural deformation and loss of focus until the heat differential between the inside and outside portions of the camera were equalized through conduction. Mattern suggests a ventura blind used like a beach umbrella as a possible solution for its concept of a combination tripod-mounted, hand-held camera.

Fairchild and Goebel feel suspension, does not pose a great problem for small, hand-held cameras in the "ten light" Apollo landing area. Temperature inside the Apollo vehicles, moreover, is planned for a 50-110° range—well within present camera limitations.

- **Pressure:** Camera design for a lunar surface pressure in the vicinity of 10<sup>-12</sup> torr will require careful selection of materials to avoid swelling of metals and "creeping" of mechanisms from vacuum distillation of lubricants. One solution suggested by Goebel and Mattern is to paint the camera so that its elements will be preserved in the order of 10<sup>-12</sup> torr, to make the types of materials and lubricants less critical.

Goebel, however, believes the most satisfactory approach is to design a camera to operate in the lunar vacuum.

A Mylar type film has been suggested in having good vacuum properties and low temperature flexibility compared with normal plastic base films.

Elimination of vacuum and lack of vibration in cameras will require further study, the companies say.

- **Radiation and cosmic rays:** Radiation produces a number of harmful effects on photographic emulsions, including induced contrast, latent fog level and increased grain size. For the Apollo mission, Goebel feels it is impractical to shield a hand camera from radiation or cosmic rays with any known materials. Because of the harmful effects of radiation on organic compounds—mostly organic and structural changes—a lunar camera should avoid plastics in means of saving weight, Goebel says. In addition, Goebel recommends organic materials be kept away from film due to their tendency to alter the clear structure of the emulsion when in close contact.

Fairchild believes simple shielding and the bulk of the camera body itself



GRAFLEX HAS DESIGNED A model of a hand-held camera for lunar exploration by astronauts. Gauged ventura blind, which is to be mounted on top of the camera, is not shown.



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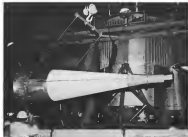
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### ABRES Experimental Re-entry Body Shown

Re-entry body Rex 3 (rotated conical) aerodynamic cross-section, developed by Chrysler Corp., was tested in a recent launch aboard an Atlas D ICBM from Vandenberg AFB, Calif., the fourth in a series of launches designed to advance the state-of-the-art of re-entry vehicles. The program is being conducted by Advanced Ballistic Re-entry Systems Office (ABRES) of CNAS Ballistic System Div. The elongate nose of the body, marked by the handling slugs, is part of long, slender shape intended to induce re-entry cross-section. Re-entry body is coated with special radio absorbing material, developed by Convair Corp.

21 in. The eye would be topped by a parabolic window. It would be supported by a center-mounted, 41 in. handle fixed with a trigger to the shutter action.

The film would be dual, 35-mm. Mylar type, double-perforated film strips packed in standard cassettes arranged one above the other horizontally across the camera. Unlike most 35 mm. packing, in which the film is wound onto a spool and reloaded into the cassette, Giffels suggests using two cassettes with each film strip with the film pre-loaded.

This method would ease an astronaut's task of loading the film while wearing space gloves, and would shorten the need for retooling. Each cassette would contain 19 frames, 24 x 36 mm. each.

By using one color and one black and white film, a single cassette can accommodate three modes of operation. At the option of the astronaut, either color or black and white exposure could be taken. Field indicators, and set for exposure of both color and black and white simultaneously, the camera would produce stereo.

Giffels says it favors a rotating disc, topographic shutter for panoramic capability, and laboratory-type operation. With this type of shutter, a single rotating disc with its shutter opening could sweep past the upper and lower film strips and permit switching from

one mode of operation to the other with maximum complexity.

Film transport might best be accomplished electrically, with a mechanical stand-by system, Giffels says. The camera suggests that a small electric motor be located in the handle with power supplied by a separate battery pack or from an outlet in the astronaut's life support pack. Frames could be changed mechanically in case of power failure by twisting the handle, according to the company.

Conventional, multiple-lens optical lens mounts for housing may not prove feasible in space because of their dependence on lubrication for smooth operation. Giffels suggests a removable disc arrangement, seating several lens and filter combinations. For a given shot, the astronaut would turn the disc to line up the desired lenses and filters. If the lens and filter desired were not on the disc, it could be quickly replaced with another containing the proper one. An independent display on aperture disc, mounted within the camera behind the lens disc, would regulate the light admitted to the camera.

Because of the strongly collimated light on the moon, Giffels would accommodate a 1 day, narrow field of view, collimating telescope camera unit which has been designated in the camera's window. The exposure meter then gets a reading on the actual object to be photographed. In the 19-



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## HOW KEYS TO OUTER SPACE SECRETS WERE FOUND ON EARTH

When Eimac built its first vacuum power tube many years ago, we had no idea we were starting on a path that would lead us one day to outer space secrets. But we were. ■ A surprising number of materials that are now coming into prominence in aerospace hardware are well known at Eimac. For more than ten years we have kept a metallurgy laboratory busy dealing with the behavior of metals like titanium, tantalum, rhodium, columbium, and niobium, in a vacuum and at extreme temperatures. Eimac was the first to exploit the desirable electrical and physical properties of ceramics for electron power tubes, and remains today their largest manufacturer.<sup>1</sup> At Eimac, the once black art of anointing metals and ceramics has become a science. This experience makes it possible for Eimac to design aerospace structures that will retain their strength in such highly corrosive environments as liquid potassium, cesium, and even lithium. ■ Among Eimac's notable accomplishments in the aerospace field are the development of hermetically sealed ceramic-metal plugs which give ready plug-in access to thermocouples in read temperature made klystrons (or rockets)...nuclear batteries...hermetic seals to isolate reactive elements in nuclear generators...sapphire-to-metal bonding of rf and optical windows. These are but a few of Eimac's new contributions to aerospace technology which have resulted from years of expertise in vacuum tube manufacturing. ■ We recently successfully designed rugged new electro-explosive devices<sup>2</sup> for rocket use. And we did it in less than four months. Reaction this quickly was possible only because we had the basic technology already at hand. Pin-to-ceramic and ceramic-to-body bonds are basics of vacuum tube quality proved reliable in more than ten years' manufacturing history. These Eimac expanding bridge wire devices are now being flown on the new Palomares A-1 developed by Lockheed Missile and Space Company, Sunnyvale, California, for the U.S. Navy. ■ In short, through long experience designing and building electron power tubes, Eimac has created keys to new aerospace technologies, because we had to find out many answers that weren't generally available. We're taking these technologies out of our pockets to help unlock more of the mysteries of outer space, helping to open the way to new aerospace developments.

- 1 We have a booklet concerned with strong facts about our ceramic-metal replacement. It is yours for the asking.
- 2 They're detonators and igniter. Want details? We'll be happy to send you more information.



### EITEL-McCULLOUGH, INC.

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Hoboken, New Jersey Division, Inc., Queens, New York  
Eitel-McCullough, Inc., S. A., Geneva, Switzerland

(Continued from p. 61)  
Cassini Div. of General Dynamics Corp., San Diego, Calif., has been awarded a \$51 million follow-on sub-contract from Lockheed-Gompa for 127 engines for the Air Force/Lockheed C-141 StarLifter jet transport.

Raytheon has received an add-on Air Force contract for \$17 million for Project Red M4, an even-threshold SCBM detection system, bringing total program award to date to \$7.4 million.

Marx Co., Baltimore, Md., has been selected by the U. S. Atomic Energy Commission as one of two contractors to begin development of nuclear electric generators for communications satellites. The other contractor is Capital Electric Co., Valley Forge, Pa. Marx is exploring the use of Stirling-90 as fuel for the reactors under separate contract. Stirling-90 is being considered because of its low cost and abundance. Previous space mission has used Plutonium-238 as fuel.

Pratt & Whitney Div. of United Aircraft Corp. will conduct further development of its RL-10 liquid hydrogen-oxygen rocket engine under a \$3.5 million contract extension from National Aeronautics and Space Administration's Marshall Space Flight Center. Work will include engine modifications and testing.

Standard Corp.'s Aviation Div., Rockford, Ill., will develop and produce a ground-controlled-speed device to run the 400-, 400-lb. jet electrical generators for the Douglas DC-9 two-jet, short-haul transport. Contract was reported to be in excess of \$2.5 million.

Kellett Aircraft Corp., Wilton, N.Y., will supply hand-held, gas-cartridge-actuated devices to cut parachute harness, disintegrate, straps and other materials under a \$9,500 Navy Air Engineering Center contract. The devices are used in stress testing operations.

Boeck Aircraft Corp., Wichita, Kan., will contract to supply bomb engines and containers under a \$3.3-million follow-on contract from the Army. Total dollar volume of work under the program to date is \$5.1 million.

Emerson Electric Mfg. Co.'s Electrotherm and Space Div., St. Louis, Mo., will develop a combined weapon system for Bell UH-1B helicopters, integrating the M6 and M6A1 rocket gas injectors with two Aero 60, 275-in. folding-fuel aircraft rocket pods. Contract was awarded by Army for an undetermined amount.

(Continued on p. 67)



Northrop's highly versatile F-5 MAP supersonic fighter

## Once again ... CECO Fuel Pumps were selected

Northrop's highly versatile F-5 MAP supersonic fighter is powered by two General Electric J85 afterburning jet engines equipped with fuel pumps engineered and precision-produced by Chandler Evans.

This CECO product on the Northrop F-5 joins a distinguished line of pumps, atom fuel controls, afterburner controls and other jet engine components in a array of important military aircraft as well as with many of the latest and finest missiles and commercial aircraft.

CECO is pleased to be "known by the company its products keep" and by the records those products establish.

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## Goodyear Aerospace has proved experience in plastics

Aerospace plastic experience at GAC—Goodyear Aerospace Corporation—covers everything from: nose- for jet pilots' helmets to reference for space vehicles—flexible high-temperature-resistant cockpit canopies to 148-foot-diameter ground-based radomes—from glass filament-wound motor cases for Polaris A-3 to radomes for German reentry vehicles.

Creating products like these calls for a knowledge of plastics in virtually every physical form and chemical com-

position... complete environmental and physical test laboratories... glass full development and production facilities.

Most important, it calls for a large staff of expert plastic engineers and associates who, in turn, can call on GAC's capabilities in systems management, instrumentation, avionics, advanced electronics, expendable structures, ground support, avionics systems and other aerospace areas. These aerospace capabilities are ready to help on your project,

too. Write Goodyear Aerospace Corporation, Box 5604E, Akron, OH 44316.

Some aerospace systems with Goodyear Aerospace Corporation plastic: McDonnell F4C • Long Termco Wright F7D and Norair F7A canopies • Grumman A-6A honeycomb radomes • Boeing T17 and T21 windows • RCA BMEWS 140-foot plastic radomes, Martin in Akron, Ohio, and Litchfield Park, Arizona.

GAC participated in the development of and is now producing the plastic filament-wound first stage rocket motor case for the Polaris missile. GAC has been much in the forefront of developing space and missile plastic rocket motor case qualified for U.S. production.

**GOOD YEAR**  
**AEROSPACE**



## This is an incandescent ball of gases, plasmas, magnetic fields, thermonuclear reactions and mysteries.

BUT NASA has wanted to throw some light on it.

After all, the sun does nothing like on earth. It disrupts our communications, pours deadly radiation into space and makes our weather do tricks.

So we need to learn the how and why and when of the sun's phenomena. And in the process pick up some basic facts about the whole universe.

So far the trouble has been that our atmosphere acts as a barrier. It makes optical and photographic and spectrographic images dimmer and scatters. In fact it completely stops most

of the sun's radiation spectrum.

Now... if we could only put our instruments outside the earth's atmosphere... in a new and extremely sophisticated machine... pointed precisely at the sun.

Today, development work for that machine—the Advanced Orbiting Solar Observatory—is being performed at Republic, under a prime contract to NASA/Goddard.

The sun will orbit 300 miles above the earth. In sunlight unobscured for months on end. Carrying about 250 pounds of instruments to

collect, store and transmit data on the sun's gamma-ray, X-ray and ultraviolet activity.

It will be aimed at the sun with an accuracy of five seconds of arc. That's like shooting at a dime one-half mile away. And letting it.

NASA's Advanced Orbiting Solar Observatory will look something like the model below. Nobody expects it to find all the answers that solar physicists and astronomers have sought for 350 years. But after it has studied that incandescent ball for a while, we'll be a lot less in the dark.



(Continued from p. 62)  
American Machine & Foundry Co. has bought the Naval Ordnance Plant in York, Pa. for \$9.6 million. Work will begin at the new plant on \$25 million in Navy contracts, including maintenance contract for existing equipment and gun direction.

Maclean Powder Co., Magna, Utah, will continue research and development work on improved Stage 3 Minuteman ICBM gases under a \$5.3-million Air Force supplemental contract.

Douglas Aircraft Co., Long Beach, Calif., will build A-10 Thunderbolt II under a \$46.7-million firm fixed price contract from the Navy.

Beckman and Whitley, Inc., San Carlos, Calif., will provide contract services for Air Force's proposed X-15 (Dyna-Soar) test vehicles. The \$165,000 contract was awarded by Boeing.

Boeing Co., Seattle, Wash., and NASA have signed a supplemental agreement to the contract for development, fabrication, and test of the first stage of the Saturn 5 space vehicle at an additional cost of approximately \$27.4 million.

Yale University, New Haven, Conn., has been awarded an \$83,785 NASA contract to design and develop a worldwide radio monitoring network for studying Jupiter. Primary function of the network will be to measure the low-frequency radio waves spontaneously emitted from the planet. The monitoring system will consist of stations located at approximately every 90 deg in longitude around the world.

General Dynamics/Turkey, Inc., has been awarded \$2.9 million for contract R&D work on the Radvay surface-to-air guided missile.

General Precision, Inc., Little Falls, N.J., has been awarded a \$3.6-million Army contract for Porting outside equipment.

Beltek Instrument Co., College Point, N.Y., will build 12 Hawk missile trainers under a \$2.2 million Army contract.

Blount Res. Corp., Montgomery, Ala., has been awarded a \$5-million firm fixed price Air Force contract to build a 78-jet-engine electric gas dynamometer facility at Wright Patterson AFB, Dayton, Ohio.

Rohco Corp. of Anacost, Corvallis, N.J., will continue design, manufacture



Model PA-100  
Maser Assembly

## LOW NOISE MICROWAVE AMPLIFICATION WITH MASERS

- satellite communications relay
- space probe tracking
- radio astronomy

If you are engaged in advanced aerospace studies involving high sensitivity radio, space communications, low noise radioactivity or radio astronomy, you are aware of the importance and increasing use of masers in microwave amplification.

Masers are used of necessity whenever low noise is a prime requirement. Laser Systems Center is offering in laser/maser R&D and manufacturing, now offers several varieties of masers for use in the X, K, and KU bands. These include flexible cavity masers or complete maser refrigerator packages (gold-coated cavity, helium dewar, magnet, RF amplifiers, and detection and display equipment).

Typical signal characteristics (F) from 10 to 100 mHz using circular input and open cycle refrigerant at 4°K. 10% output receiver noise temperature: 25°K to 30°K. maser preamplifier noise temperature: 70 to 20 dB of gain/amplifier gain. 5 to 30 mHz bandwidth.

Specialized maser systems! Custom built units are our specialty! Send us your requirements!



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# STOP pump wear? ELIMINATE valve erosion?

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New studies by PALL and scientists at leading aerospace and industrial facilities have proven that the cause for continued wear is extremely fine contaminants circulating in the fluid. Too small to be seen by the naked eye, these less than 5-micron (0.0005") diameter particles act as a lapping compound and grind away at the surfaces by getting between the moving parts.

Naturally, these ultra-fine particles pass right thru the 10-micron nominal (absolute 25-micron) filters used in most systems. Most of them even go thru the nominal 1.5-micron (absolute 15-micron) filters found in a few of the latest systems. While these filters prevent passage of the large particles that might cause a catastrophic failure, they do little to control the wear caused by less than 5-micron contaminants.

Now there is an exclusive 3-micron absolute filter developed to continuously remove "lapping" size range particles, reducing wear and erosion to a negligible amount. Based on an epoxy impregnated and coated paper filter medium called ULTIPOR 3, these dependable and relatively inexpensive filters are available for a wide range of system requirements.

## PALL 3-MICRON ABSOLUTE FILTERS

Sized to AN225-4A (1 3/4" dia. x 4 1/2" long). Both 2-stage & 1-stage filters fit into a standard MS28720-12 housing. Absolute 3-micron particle removal per MIL-P-27856A (USAF). Absolute 1-micron rating using standard APM-F-9 glass beads. • Available off-the-shelf, with or without housing. • Zero media migration. • Disposable. • Low cost.

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## Minuteman Staging Sequence Demonstrated

Separation of the second stage from the first stage of a USAF/Borg West Minuteman ICBM took 0.25 sec. in a recent test series of the solid rocket plant of Aerojet-General Corp., which makes the second stage motor for the missile. The low second stage motor (upper left) was connected by eight hardware arrangements to a dummy first stage (filled with water) open to weight in an operational test stage. From left (upper right) seven interstage struts in the second stage spun. During first stage a thrust away about 100 yd. in second stage motor develops full thrust (lower left). Exhaust temperature after separation (lower right) is more than 1,000°F.



and test of Multi-System Test Equipment for various attitude systems under a 54 million Amp contact.

Kodansha Instrument Corp., Secaucus, N. Y., will produce the Shidenki Shiloh Weapon System Target Visual Simulator, a viewing device which provides target cues with a presentation of realistic simulated battlefield situations. The visual subsystem presents a 360-deg panorama from the perspective and tanking telescope. Moving targets are presented in color into the two viewing elements in real time motion accuracy of infinity down. The simulator will allow the viewer to see the actual smoke and flash obscuring the telescope.

at well as the recording monitor, and their strike or miss on the target.

Precision Corp., Flushing, N. Y., subsidiary of General Controls Corp., will provide ultrasonic pigtail pigging system for the Titan 5 crew vehicle under a \$177,615 contract from Martin-Baker. Signals from the sensor will monitor the depth of liquid pigtail and initiate the staging sequence.

Grossman Aircraft Engineering Corp., Bellingham, N. Y., will build and outfit a three-degrees-of-freedom great diameter flight simulator under \$111,544 contract from North American Aviation's Columbus Div. Cockpit of

the simulator will consist of a side-by-side seating arrangement with capability of producing a cockpit velocity of 20 g's and acceleration as high as 4g.

Jackson & Mordue, Inc., Boston, has been awarded a \$92,710 contract by the National Aeronautics and Space Administration to study the type and cost of equipment required for NASA's proposed Electronics Research Center (NSF Sept. 2, p. 18).

Lockheed Aircraft Corp. will conduct research on the simulation of effects of high altitude nuclear explosions under a contract to be awarded by Office of Naval Research.

# AERONAUTICAL ENGINEERING



CANADAIR, LTD.'S CL-84 (left) wing VTOL utility transport is shown as an auto's drawing (left) with the wing and tail folded for vertical flight and lowered for horizontal flight. As an inland helicopter escort, considered a primary role by Canadair, the CL-84 (right) will carry a 20-man gun pod, two rocket pods and a 7.62-mm. machine in the nose.

## Canadair Completes CL-84 VTOL Design

By Donald E. Fisk

**Montreal, Oct.—**Final design of the twin turboprop CL-84, a six-wing V/STOL utility transport, has been completed by Canadair, Ltd., and work on a flying prototype is scheduled to begin next month.

The aircraft is being developed under a \$10-million program funded jointly by Canadair and the Canadian government (AW June 5, p. 28). It will produce one flying prototype, a backup engine and an extra set of power equipment—engine, transmission and propeller.

Rollout of the flying prototype is scheduled for December, 1964. Six months of ground evaluation—including static tests, structural checks and a 200-hr engine test program—will precede its first flight, which is scheduled for July, 1965. The schedule then calls for the construction of 150 flying test hours on the prototype by September, 1966.

The CL-84 is a high-wing monoplane with a semi-monocoque fuselage of conventional aluminum skin and stronger construction. It is designed for a variety of military missions, ranging from assault transport to armed helicopter escort. The aircraft also is being proposed

for some short-haul commercial roles.

The aircraft will have a maximum gross weight of 12,200 lb. for VTOL operations and 14,500 lb. for STOL operations. Its payload under the two modes of operation will be 3,100 lb. and 3,600 lb. respectively.

The CL-84 will be 45.5 ft. long and 14.0 ft. high at the tail. It will have a subdivided fuselage with a two-piece cockpit and a cabin 10.5 ft. long, 4.7 ft. wide and 4.5 ft. high. The fuselage will be 5.4 ft. wide and will have a ground clearance of 3.1 ft. Access to the cockpit, which will seat the pilots side by side, will be through a rear, upward-swinging cargo door.

No other access to the cockpit is planned, but blowout escape panels will be located in the roof over each pilot. Ground-level ejection seats, capable of boosting the pilots past the wing in its uproot position, will be installed.

The cabin will have a cargo volume of approximately 200 cu ft. and also will be rigged with bench seats for 12 combat-equipped troops. A bicycle loading gear will be used, with dual wheel units at all three points. They will have 40 psi tires for rough field operations. The nose wheel unit will retract forward into a well between the pilots' seats. The main wheels will retract into fuselage mounted on the lower sides of the fuselage.

Two 1,400-shp. versions of the Lycoming T53 turboprop engine will power the CL-84. They will be interconnected by cross-shafting to a pair of four-bladed, 14-ft. variable pitch propellers and a 7.62-cal. gun.

Four of the engines, designated T-53-LTC-1K-6A by Lycoming, have been

ordered by Canadair. They will be delivered next October with their 50th preliminary flight rating test qualification, which will include operation in the vertical position. These advanced versions of the T53 have redesigned compressor sections, which have increased pressure ratios and intake air flows, and new engine fuel systems.

Two of the engines will be used in the flying prototype. The other two will be used as engine and propeller static thrust tests and will be available for evaluation in the fuselage advance if a second flying prototype is required.

Canadair, a subsidiary of General Dynamics Corp., contracts a negotiating with United Aircraft Corp.'s Hamilton Standard Div. and with Curtis-Wright Corp. for the propeller subcontract. Static thrust tests are being conducted by Canadair with models of engines from both companies. The final design will have glass fiber blades with hydraulically controlled pitch.

Canadair hopes to include the whole aircraft in a single contract covering the propellers, gearbox, shaft coupling and tail rotor, according to Fred C. Phillips, CL-84 program manager. Phillips and the contract would

include a three-person crew, covering the static thrust qualification, static static thrust in the VTOL mode, determine the gross weight of the aircraft.

For vertical takeoff, the propellers will have to generate thrust equal to 1.05% of the maximum gross weight of the aircraft. The aircraft initially will be supported by the dynamic ground of feet, but this will be treated as a bonus.

The engine will be mounted in nacelles under the wing, which will rotate through 90 deg. for vertical flight. The engine nacelles will be attached to the wing. The propeller assembly will be controlled all the front of it and the engine all its back. The nacelle, which will not be a load bearing unit, will function much like a jet engine pod, with its bottom portion forming a clean air intake for the engine and the tail rotor.

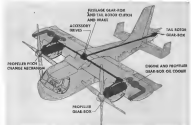
The engine and propeller gear boxes will be interconnected through a cross-shaft linkage. An output shaft will take power from the rear of each engine gear box and connect it to the cross-shaft, which is in line with the wing's pivot axis. The cross linkage passes through

a fuselage gear box located in the wing root and connects with the output shaft from the other engine. This couples the propeller gear boxes and makes it possible to drive both propellers with one engine in case of an engine failure, which would be catastrophic in vertical flight if they were not interconnected.

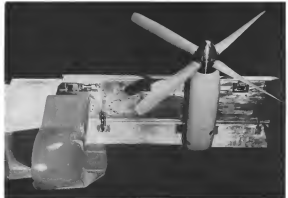
The tail rotor transmission also will be driven by the fuselage gear box through a shaft extending back along the top of the fuselage. Power outputs to drive the aircraft's accessories from the wing is taken from the fuselage gear box. Rotating the cross-shaft is line with the wing's pivot point makes it possible to design a simple Unalut linkage, since the entire assembly pivots as the wing is tilted for vertical takeoff.

The wing also will be designed to look at intermediate angles for STOL operations, such as takeoff in 500 ft. over 50-ft. obstacles. Phillips said that even under similar conditions there probably will be maximum stall fields available from which the CL-84 can be operated as an STOL aircraft. This made possible will be used whenever possible because of the increased performance it offers, he said.

The CL-84 wing will be wingroot and



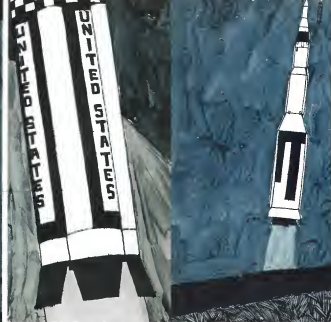
**POWER TRAIN IN THE CL-84** will begin with the output shafts from the engine gear boxes, which connect to the cross-shaft. This runs along the wing's tilt axis and connects the two propellers. Tail rotor and accessories are driven into a fuselage gear box. Wingtip and tail rotor shafts will be replaced with ones in the nacelle when installed.



**HALF MODEL OF THE CL-84** VTOL aircraft currently is being tested in the low-speed wind tunnel at Canadair's parent company, General Dynamics Corp. The model is about one-quarter scale. It is being used to measure aerodynamic forces acting on the airplane and to investigate airflow characteristics of the wing and nacelle in the horizontal, intermediate and vertical positions. Wing in the down position is in the intermediate position as it would be for STOL operations.



Steering a rocket in flight calls for dynamic controls.



That's where we fit in.



We pioneered movable exhaust nozzles for rocket thrust vectoring. We are also producing secondary injection and developing solid injection techniques. These are typical examples of our ability in critical areas of design, production, quality control and performance. Our other programs include propulsion controls and landing gear for both aircraft and spacecraft. To find out what we can do for you, write General Sales Manager, South Bend 20, Ind.

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**NEW**  
**PROPULSION**  
**OPPORTUNITIES**  
In Southern California

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Initial assignments will be at STI's new Super Technology Center in Redondo Beach near Los Angeles International Airport with opportunity for transfer to STI's multi-million dollar propulsion facility now under construction in the San Clemente/San Juan Capistrano, California area.

Requirements include a degree in engineering or science with appropriate experience.

## ENGINE DESIGN, DEVELOPMENT AND TESTING

Experience in the design, development and testing of liquid propellant production systems, rocket engine feed system components, thrust chambers, injectors and thrust vector controls.

ROCKET ENGINE TEST STAND  
INSTRUMENTATION AND CONTROLS

Experience in the design, installation, operation or maintenance of liquid rocket engine test stand data acquisition (analog and digital) and control systems.

## DISCUSSION AND ANALYSIS

Experiences in heat transfer, hydrodynamics, gas dynamics, combustion, additive materials and data processing and analysis.

For interview in your area in the near future, act NOW! Forward your resume to: STI Professional Placement, Department AW 11, One Space Park, Redondo Beach, California 90260. This is an equal opportunity employer.

### CL-84 Prototype Performance Estimates

ITEM	VTOL MODE	STOL MODE
GROSS WEIGHT AT SEA LEVEL ISA - 28	12,260	14,700
GROSS WEIGHT AT SEA LEVEL, 95°F - 18	10,680	12,700
GROSS WEIGHT AT 4,000 FT ISA - 18	10,480	12,700
FUEL LOAD INCLUDING RESERVE - 18	3,600	3,600
RANGE* AT SEA AT 2,000 - 18 MI	300	315
PAYLOAD FOR SL RANGE, ISA - 18	3300	3600**
PAYLOAD FOR SL RANGE, 95°F - 18	1500	3500
ENDURANCE AT SL AT 100-1500 - HR	2.0	1.9
ENDURANCE AT SL AT 50K	1.6 HR	1.1
HOVERING ENDURANCE AT SL	0.9 HR	-
MAX SPEED HS, POWER SL ISA - K	287	284
MAX SPEED NORMAL POWER SL ISA - K	274	270

1. *Staphylococcus aureus* (S. aureus) (Gram positive, cocci, catalase positive, coagulase positive, novobiocin sensitive, DNase positive, gelatinase positive, urease negative, indole negative, methyl red positive, Voges-Proskauer negative, citrate utilization negative, nitrate reduction negative, hydrolysis of starch, gelatin, and casein positive, and hydrolysis of Tween 20, Tween 80, and Tween 40 negative).

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will have a rectangular platform with a 33-0 span. It will have full-span Kruuger flaps on the leading edges and outboard ailerons on the trailing edges. These control surfaces will provide roll control in vertical flight and roll control in horizontal flight besides supplementing the lift of the low aspect wing.

A fixed section of Kruggs flap with an elongated chord will be mounted on the front of the wing section that rests on the leading edge. This will improve flow curvature over the wing root and prevent the airflow from bending back during slow flight.

### Movement Controls

Two individuals, driven half-way into attached forward of the main wing spar, will be used to raise the wing for vertical or STOL flight. The large brackets will be located behind the main spar. Vertical motion of the aircraft will be regulated by varying pitch on the main propellers, while the engines are maintained at a constant rpm with mixers.

Movement around the tail cone will be controlled by differential extension of the main pectoral patch. Yaw movement will be controlled by differential extension of the *hypocleonus* in the pectoral *apertum*. Pitch movement will be controlled by varying the tail cone *lateral* angle. The tail cone will have an upward bend that will be used to provide the patch control desired throughout vertical flight.

Which phenomenon in horizontal light, a mechanical mirror and will phase out the controls used in vertical light and phase in conventional controls. The principal visual fall into the and will be the same tilt angle.

As this changes, gear ratios in the steering unit will change. Yaw control, for example, will be transferred from differential slip/slide deflection to the rack. As the transition proceeds into the horizontal mode, the tail rotor will be stopped and locked, and the differential variation of main propeller pitch will be phased out as a control action.

The basic cockpit controls in the CL-84 are conventional stick, throttle, rudder pedals and propeller pitch control units. The engine system to which they are connected will be designed to produce control inputs, responses to manual control movements in vertical, horizontal and horizontal flight. This will eliminate special training for pilots of conventional aircraft who make a transition to the CL-84, according to Phillips.

The design and operating mode of the CL-84 created some aerodynamic problems not encountered with conventional aircraft. The changing angle of the CL-84's wing during transitions, and the destabilizing effect of the larger than normal propellers dictated a special tail design, for example. It is considerably larger than that required for a conventional aircraft of the same size.

## Angle of incidence

The tail has a large, seated vertical stabilizer mounted on top of the fuselage and two smaller ones mounted on endplates on the horizontal stabilizer. The horizontal stabilizer also will have a 20 deg variable angle of incidence, which will be regulated by the main wing tilt angle. Its vertical or lower flap, the elevators, over the wing will not affect the tail surface, but wing fences built with C1-30 models showed that



move it, raise it, rotate it!

**GROUND SUPPORT EQUIPMENT DEMANDS POWER—PLENTY OF IT. AND VICKERS HYDRAULICS CAN RAISE—MOVE—TRAVERSE MOST ANYTHING.**

Accuracy is extraordinary. Control is positive. Acceleration, deceleration, reversal are faster than with any other power transmission. How fast? In just 20 milliseconds a piston pump can go from zero to maximum output! And, you can start and stop accurately at speeds near zero.

Wacker's hydraulics offer higher horsepower in smaller developments—the widest range of hp ratings available. Hydraulic power means added safety in explosive atmospheres. In high-temperature areas, fire-resistant fluids can be used.

Yes, you get not only a comprehensive line of hydraulic components and power packages, but you cash in on skilled manpower, too. Remember, Wickers hydraulic engineering staff is the largest most experienced anywhere. And backing them is an unmatched R&D facility.



Many more don't see Application Engineering Data as part of their job. It's usually the sales or marketing department's responsibility to provide the data. And that's a problem, because sales and marketing people don't have the technical knowledge to provide accurate data.



REVISED ON STREET NAME CHANGES





## EBW Simultaneity:

That's the phrase from ITT for microsecond accuracy on modular Exploding Bridgewire Systems.

□ We conceived it, designed it, tested it, and with large scale production proved its reliability and safety on the most successful ballistic missile using high-energy, high-altitude exploding bridgewire ordnance. □ Here is a team of ITT electroexplosive ordnance specialists: Patrick J. Macken (right), Manager of the ITT Ordnance and Aircraft Power Section, confers in an environmental testing lab following another successful high-altitude test of a new ITT exploding bridgewire ordnance initiator firing unit. With him are George H. Askins, Director of Engineering Development (left), and Roger D. Loker, Senior Member of the Technical Staff.

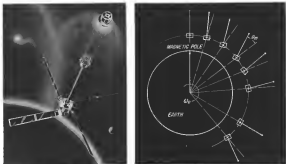
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## AVIONICS



GRAVITY GRADIENT STABILIZATION was developed originally for Transit navigation satellites. The technique uses a self-correcting metal boom with a mass at the end which causes the satellite to seek vertical alignment. The satellite swivels slowly about the vertical (dashed, right), but the amplitude of swiveling can be greatly reduced by using another mass attached to the boom through a weak damping spring.

## Gravity Gradient Feasibility Test Planned

By Philip J. Kline

Washington—An extremely simple, lightweight and potentially long-lived device for keeping a satellite oriented toward the earth, using the principle of gravity gradient, is promising increased interest for possible use in reconnaissance, meteorological and geodetic satellites.

Feasibility of the gravity gradient technique, a passive one requiring no electric power, was first successfully demonstrated by the Johns Hopkins University Applied Physics Laboratory (APL) in the Navy Transit 5B navigation satellite launched June 13 (AW July 29, p. 25). The concept had been suggested in the late 1950s by a number of scientists, and a configuration somewhat similar to the one used by APL, called "ventrif", was proposed by L. J. Kline of General Dynamics/Astronautics in December, 1960, at a meeting of the American Rocket Society.

Defense Dept. and the National Aeronautics and Space Administration have recently formed a committee, at Pentagon request, to formulate a program

to test feasibility of gravity gradient stabilization at altitudes of several thousand miles for possible use in a second-generation navigation satellite vehicle communications satellite. Gravity effect decreases as the second power of distance from earth center and has been demonstrated only at altitudes of 500 mi., but APL scientists are confident that it can be used with little increase in weight at altitudes of 5,000 mi., perhaps beyond.

NASA also is considering the use of gravity gradient stabilization in later versions of the Titan reconnaissance satellite to achieve earth orientation with minimum cost and complexity for maximum orbital service life. However, the attitude stabilization requirement for a reconnaissance satellite is much more demanding than for a communications satellite.

The technique developed by APL for Transit was reported by Robert E. Fendell and Frederick F. Molyer at the recent Elm Coast Conference on Astronomical and Navigational Electronics. The complete stabilization device will weigh about 9 lb. and use two 108-in. long beryllium-copper

tape, 2 in. wide and 0.002 in. thick, which is wound flat over a drum with one end of the tape secured to the drum. Pairs to launch this tape is generated from energy by an explosive which later is released by an explosive squib detonated by radio command when the satellite is in orbit, Molyer reported.

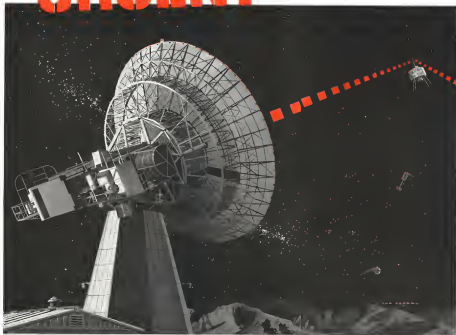
The metal tape is pretensioned so that when the squib is detonated, natural forces will cause it to unravel from the drum. As it unravels into space, the tape will curl into a circular end (first attempt to use gravity gradient stabilization on the Titan satellite launched in 1961 failed because the electric motor provided to unroll the tape failed to function, which led to present redesign).

The extensible boom mechanism was built by de Havilland Aircraft of Canada.

Attached to the free end of the 108-in. long metal boom is a cup-shaped mass which houses a 70-lb. axial spring with an diameter of 7.8 in. One end of the spring is attached to the boom cup-mass while the other end attaches to another mass. The

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spring and its mass are temporarily secured to the cup-shaped end of the 100 lb. boom by a nut and washers.

Releasing first the spring's mass and then individual coils of the spring itself, until the spring and its mass extend out from the end of the boom (see sketch). The combination of the spring and mass serve to help damp out oscillations (bouncing) of the satellite about the local vertical, i.e., the line to the apparent center of the earth. When extended, the mass at the end of the boom weighs about 1.85 lb. while the mass at the end of the spring weighs 1.85 lb.

#### Gravitational Field

In this configuration, torques generated by the earth's gravitational field attempt to align the boom's long axis to the local vertical (the line to the center of the earth). When the plane of satellite motion (pitch axis) and at right angles to it (roll axis). The action can be compared grossly to that of a pendulum, except that due to the satellite's orbital velocity the boom can align itself either toward toward the earth or away from the earth. For this reason, the satellite must be oriented so the boom will be aimed in the desired direction (up or down) before it is extended.

The magnitude of the gravity gradient torque generated is an inverse function of the square of the satellite's distance from the center of the earth, a distance function of the sine of twice the angle between the satellite's long axis and the vertical, and the difference between the moment of inertia about the roll/pitch axis and the moment of inertia about the yaw axis—ensuring a symmetrical cylindrical satellite configuration.

As seen by an observer fixed in space,



**SELF-EXTENDABLE** boom, containing a 100 lb. long nylon boom, two masses and a helical spring, is made by de Havilland Aircraft of Canada. The total weight of the self extendable boom is 9 lb.

an earth-oriented satellite must make one complete revolution during each orbit.

The torque that is needed to produce this one-revolution-per-orbit rotation is supplied, in this case, by gravity gradient effect. If the satellite is oriented so that the boom axis is nearly aligned with the vertical, as the satellite moves inertia will cause it to try to maintain its position in space until its boom axis is far enough off the vertical to generate sufficient torque to cause the satellite to begin to swing back toward the vertical.

Because the satellite behaves somewhat like a pendulum it will overshoot

the vertical until sufficient gravity gradient torque develops to cause it to swing back in the opposite direction, as shown on the sketch p. 79. The natural period of this oscillation is an inverse function of the satellite's angular velocity and the ratio of its yaw axis moment of inertia to its pitch/roll axis moment of inertia.

#### Transit Configuration

In a gravity-stabilized satellite of the Transit configuration at an altitude of about 500 mi., the natural period of oscillation in the orbit plane is about 55 min. while the period at right angles to the orbit plane is about 50

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# USED

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**USED ON SATURN**, Motorola Model MCR-100, shown in illustration above, provides 10 channels, weighs only 2 lbs., 78 in.

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features an isolated ground system, supplies 3 decoder channels, weighs 3 lbs.

**USED ON MINUTEMAN**, MCR-405, contains 4 decoder channels, weighs 2 lbs., 15 oz. **USED ON MERCURY**, MCR-102/MAD-107, receiver-decoder combination, provides a 30-channel system, weighs but 3 lbs. Standard 3- and 10-channel receivers are available for fast, off-the-shelf delivery. For full performance specifications, or application data to meet other parameters, write our Instrumentation Products Group today.

**MOTOROLA** Military Electronics Division  
6001 East McDowell Road, Scottsdale, Arizona



**SHOWN PARTIALLY UNWINDING**, satellite boom consists of thin pre-stressed tubes of beryllia-copper type wound heli- centrically. When released by explosive seals, inner satellite is properly oriented as outer, internal booms cause boom to unwind tube, which curls into circular shape to form 100 ft. long boom.

mm., the difference being due to the gyroscopic effect of satellite motion in the orbital plane, according to Lockheed.

The maximum angle through which a gravity gradient oriented satellite without damping provisions will liberate is a function of the precision with which it is initially oriented to the vertical when the initial tube boom is erected and the ratio of the maximum diameter of the pitch-roll axis to the pin axis.

Where the pitch-roll axis moment of inertia is very much higher than the yaw axis, which normally would be the case, the maximum angle of swing on either side of the vertical becomes accordingly a function only of the initial angle of vertical misalign- ment at the time the boom is erected. A misalignment initially of 15 deg., for example, would result in a swing of 40 deg. after release of the vertical for a gravity gradient stabilized satellite without damping.

Disturbances of this magnitude are much too large for most applications, which explains why APL adds a damp- ing spring and mass at the end of the 100 ft. boom. The technique of using an extremely weak spring and mass, suggested by APL's Dr. R. K. Newport, is only one of several possible means of providing the necessary damping, but its feasibility has been demon- strated in the Taurus launched in June.

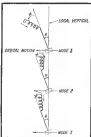
When the boom is erected by radio command, data are received which re- ceptor the beryllia-copper material holding the spring and its mass within the coplanar axis on the end of the boom to the corner of space. An information taken place, the spring mass is first to be released a few inches later and the gravity gradient force acting on the mass pulls on the spring to release it a coil at a time. As the initial tube boom starts to slowly, gravity gradient forces and libration motions will cause the spring axis to lag or lead the boom and to move toward or away from the end of the boom, compressing the spring length to about 10 ft. or extending it to about 100 ft. By this action the libration energy

is absorbed by the mechanical hysteresis of the spring and dissipated in the form of heat. To increase the damping effect, the beryllia-copper spring used in Taurus was coated with an 0.0005-in. thick layer of mechanically soft cadmium which in turn was released by an 0.0002-in. layer of deposited gold to prevent sublimation of the cadmium. The spring had a constant of  $2.14 \times 10^9$  lb./ft.

Using the configuration described, telemetry data obtained from the Taurus satellite indicates that it or- iented itself to within about 5 deg. of the vertical, oscillating through a total angle of about 12 deg. (Because of Defense Dept. security policy, APL scientists do not use the name "Taurus" but refer to the satellite by its official catalog number of 1963-22A, or just "22A.")

Launched from the Pacific Missile Range by a Blue Scout booster, the satellite was placed on a circular path orbit at roughly 400 mi. in altitude with a period of 90.75 min. and an eccentricity of 0.005. Satellite had a spin rate of about 200 rpm, some- what prior to separation from the final stage.

Shortly after separation, two 70-psi design weights attached to cables were released, a technique used previously on Taurus and earlier APL satel- lites, to decrease the spin rate to 1.82 rpm, Mobler reported. Two magnetic



**MOTION of the spring and its mass at the end of 100-ft. long boom**, due to gravity gradient and libration forces, causes exten- sion and compression of the weak spring, absorbing libration energy and damping, as in limit to major sublimation of satellite co- ordination. Several possible modes of spring- mass motion are shown in sketches above.

# USED

## TRANSPONDERS

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business ends, at right angles to the spin axis and to one another, tracing with the earth's magnetic field thus reduced the spin rate to less than 0.008 rpm after 60 hr. as a test.

At that point an electromagnet whose magnetic dipole moment was commensurate with the axis of the satellite which was to be earth oriented was energized by radio command. This generated a static magnetic field that attempted to align the satellite's heavy-metal axis to the direction of the earth's magnetic field which is horizontal near the equator but becomes vertical near the magnetic poles.

### Recess Deployment

When the satellite was aligned itself to the earth's magnetic field and the satellite is over the polar region where the earth's field is nearly vertical, the rope boom can be deployed.

During the Transit (22A) experiment, the electro-magnet was energized approximately 60 hr after the orbit insertion approximately 12 hr later when the satellite was aligned to within a fraction of a degree of the earth's field and was over the pole where the earth's field is within about 11 deg of the vertical, the boom was erected. The polarity of current used in the electro-magnet had been chosen so that it would cause the boom to be swung away from the earth. Satellite orientation with respect to the earth's magnetic field was determined by means of a flux-gate vector magnetometer on board the satellite whose output was transmitted to the earth.

### Telemetry Data

It remained about 77 sec after the spin was fixed for the boom to fully retract itself, as determined by telemetry data according to Mikkelsen. This figure was only slightly larger than that which was experienced in earlier ground tests.

To enable APL scientists to determine whether the changing mass and spring load deployed and then retracted as planned, the spring's axis was equipped with a small lamp flatter normal and its own solar cells to provide electric power. Inside the cryo mass at the end of the 100 ft boom was a photo-cell which was exposed to the flashing light from the underside of the spring's mass. The intensity of photo-cell illumination, telemetered back to earth, was a function of the distance the spring had extended and its angle relative to the boom.

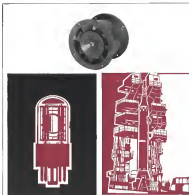
Initially the photo-cell illumination was very low, suggesting either that the spring had extended more than 100 ft or was tipped beyond the 45 deg. swinging angle of the photo-cell. But after several days the flashing light again increased in magnitude show-

ing that the spring was returning to its equilibrium extension of about 30 ft, Mikkelsen reported.

Because there is no storage of data aboard the satellite and it is unable for only 10-14 min. during each 90.7-min. orbit, and because it is floating about the vertical, it is difficult to determine precisely the accuracy of the vertical measurement achieved, Mikkelsen points out. However, within these limitations the data indicated that the satellite had stabilized to within 1 deg of the vertical along the orbital plane within one week after the boom was extended, and had achieved a steady figure in the

completeness some several days later after 21 weeks in orbit. The satellite appeared to be swinging no more than 1 deg either side of the vertical in both the orbital and cross-orbit planes.

Analysis of data from the 22A satellite showed that the side of the 100 ft boom illuminated by the sun reaches a much higher temperature than the opposite side, causing the boom to be deflected by approximately 1 deg from the vertical under such conditions. This also is believed responsible for a high frequency attitude oscillation, of about three cycles per minute, apparently caused by shock or vibration along the



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boom's length induced by the thermal bending.

By coating the boom with high-reflective material, such as silver, the heating should be greatly reduced. Mehley says, and he indicates that APL recently has obtained confirmation of this case but declined to elaborate. Presumably this is a reference to the Transit 1B satellite launched on Sept. 28.

Full technical details on the APL technique, including a discussion of the effect of star pointing angles due to earth's field, solar pressure and aerodynamic effects, are contained in Applied Physics Laboratory report entitled "A System For Passive Geometric Stabilization of Earth Satellites," by Trudell and Mehley, identified as TG-104. APL is located in Silver Spring, Md.

### \*\*\*\*\* FILTER CENTER \*\*\*\*\*

#### ►Phoenix Monomeric Screen Picked

Four semiconductor companies were picked recently by Litton Industries as multiple sources for semiconductor components to be used in the Phoenix air-to-air missile. Litton is handling these orders under a subcontract to Hughes Aircraft Co., Navy prime contractor for the Phoenix, the primary anticipated armament for the F-111B (Navy version of F-15). Best design subcontractors. The four companies, chosen as suppliers on what may be, along with Minuteman (AW Oct. 23, p. 78), one of the largest single semiconductor programs, are: Fairchild Semiconductor and Motorola (bidding about \$ of an initial order of about 80,000 units) and Siliconix and TRW. Semiconductor doing the remainder of the order. The four were picked on the basis of a funded design program conducted by Litton among seven potential suppliers (AW Sept. 2, p. 57).

#### ►Motorola Wins Automatic Competition—Motorola has been selected as

Autopilot III, of North American Aviation in sole supplier of semiconductor microcircuits for its Mosiac general purpose digital computer (AW June 17, p. 90), now in design and early development under contract. Autronics has proposed a computer of this type in the Air Force's recent competition (AW Sept. 30, p. 18) for studies of a stand-alone space guidance system. Terms contract for 17 current types to Motorola is for \$300,000.

►Choke Loss From Cind-A—Choke loss using an organic carbon



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### PROBLEMATIC RECREATIONS 198



A man picking one-inch spheres into a rectangular tray evenly fills the tray in a single layer such as disk, using a rectangular packing. Trying a different arrangement, he fills in one more sphere. He then uses a third arrangement and fills in still another sphere. What is the size of the tray?

—Conrad

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tion of piperidine and cesyrium hexafluoroantimonate in alcohol solution could open the door to a wide number of new liquid lenses, according to scientists at Electro-Optical Systems, whose first new lens was operated. The compound consists of five ligands, a chloride component not previously established, the company says. This may make possible many new chloride combinations. The lens operated by Electro-Optical is cryogenically cooled, and operates at 6,130 angstroms in the yellow portion of the spectrum. It may be capable of operating in continuous wave mode and eventually might provide higher CW power than available from lenses made of inorganic crystals.

► **Aeronautics Forces Command** and **Central Unit-A** command and control department was organized recently with an Aeronautics Data Systems Div. to exploit command and control business, particularly military systems requiring high reliability, small size and weight and ruggedness. A number of new space companies have been taking similar steps, several of them to capitalize on present and potential military tactical command requirements.

► **USAF to Test Loran Receiver-A** sample, lightweight microcomputerized Loran C receiver (AW July 1, p. 89), developed by Sperry Gyroscope under contract to Navy BuWep, will be flight tested next month by the Air Force's Aeronautical Systems Div. in a Lockheed C-119. The receiver, AN/AUN-76, uses 592 digital semiconductor microcircuits of the different types to satisfy 87% of its functional needs and to help make possible a fivefold increase in MTBF over a comparable Loran receiver. The ARN-76 is considerably simplified with operational controls reduced from 75 to 5 in design, weight cut to 20 lb from 68-75 lb. level. The company plans to build 100 models of a slightly revised version of this receiver, using microcircuits for 95% of its functions. Class, Sperry says, could be reduced by as much as 80%, dropping receiver price to \$5,000-\$10,000. Four qualified microwave suppliers for the equipment are Tera Instruments, Fairchild, Westinghouse and Central Micro-Electronics.

► **Hyperonic Velocity Scanning**—An optical technique for determining velocity of a target vehicle is being developed by Quantum Controls Corp. under funding from USAF's Aeronautical Systems Div. A prototype field will be set up that will interact with the planes at the front of the vehicle, causing perturbations in the air flow. Several possible methods of this collecting measuring tone from which velocity can be determined are under

investigation. The most promising of these appear to be the use of expensive probes. The company will be testing a breadboard prototype of the sensor in the current phase of the effort.

► **Trimouth Shows Three-Month Profit**—Trimouth Electronic Corp. reports net earnings also rose at \$175,516 for the three-month period ended Sept. 23, compared with a deficit of \$591,674 after tax carryback for the comparable period last year. Sales for the quarter were \$5,022,991 compared with \$5,610,671 for the late period.

► **Fast Microchannel Amplifier Stage**—among vacuum deposited thin film components—has been fabricated and operated by the Army's Harry Diamond Laboratories. Two 10-sec 1F amplifiers with power gains of 151 db and 147 db and a bandwidth of about 10 mc were constructed from vacuum-deposited thin-film conductors, resistors and capacitors and an inserted coil and magnetic. Spark erosion machines were used to produce dimensionally accurate stainless steel masks. Designers of the amplifier stage believe that the thin metal film resistors, deposited from a vapor source and etched, are more stable than conventional screen-printed carbon composition resistors. Thin film capacitors made from sputtered niobium and aluminum, exhibited capacitance values of 0.001 microfarad, near the upper limit for capacitors of this type.

► **High-Power VHF Multiplier**—Harmon generator using varactor which follows a 4-pole low pass filter than the previous line of conventional all-pass junction varactor, has yielded efficiencies of 70% in a frequency tripler which converts 70 mc to 150 mc, and 60% efficiency for 150 mc to 450 mc conversion with input power of 50 watts, according to a paper presented at Electronic Device Meeting by Dr. Wilton Taylor, M. J. Benavente and Dr. Gerald Schuller of Motorola Sensorization Products Div. In addition to higher power handling capability, new 4-pole low devices have greater output linearity than the abrupt junction type varactor.

► **Long-Lead Magnetics Reported**—Invited counsel for budget negotiations, developed for use with Federal Aviation Agency report two studies, is expected to slash heavily basic replacement cost of electronic equipment according to a paper at Electronic Design Meeting by Jerome Drexler, Paul Foxworth and F. A. Fackler of SFD Laboratories, Inc. The new magnetics which has operated for more than 2,000 hrs without failure, below rated 100-kr peak output, is expected to have operating cost of 35-45 cents per hour compared to about \$5.00



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► **Improved Tunnel Diode Reported:** Tunnel diode which exhibits probe-to-valley current ratio of 10:1, with maximum positive resistance and capacitance, has been developed by Interatomic Business Machines Corp. using planar construction and epitaxial techniques. Device consists of epitaxial layer of gallium-arsenide grown on germanium substrate with tunneling junction formed in silicic film to the gallium-arsenide. Fabrication technique permits peak current to be lowered to within 1% by placing negative distribution near the junction instead of conventional etching process. Experimental units operate with peak currents of 10 milliamperes and have a capacity of 1 picofarad/mil. Diode chip is covered with thin coating of high-temperature glass to protect it from contamination. Experimental diodes have been tested at 350 temperature, with 35% relative humidity. Test results show 1,000 hours of no significant change in electrical characteristics, according to a paper presented at the Electron Device Meeting by Samuel S. Ito. Paper was co-authored by J. H. Butler and Frank L. Johnson, all of IBM's Corporation in the Department of Electrical Engineering, N.Y.

► **Single-Reversal C-Band TWT Reported:** A C-band traveling wave tube, using single reversal principle which provides light weight and low noise performance, has been developed by General Electric, following recent announcement of a similar tube for X-band operation. The C-band tube, operating in the 4-8 (GHz) range, has maximum forward mean figure of 7.5 dB and maximum output signal gain of 29 dB. GE's Dr. Karl Nishi reported at the Electron Device Meeting. Output power from experimental models varies from 5.25 to 10 watts across the band. The C-band tube, like other X-band model, weighs 8.5 lb, dimensions 1 in. long and 4 in. in diameter.

► **Data Interchange With Voice-Technique** which permits transmission of up to 12 Teletype messages over a single voice channel while it is being used for voice, communications have been developed by AF Cambridge Research Laboratories. Technique is similar to voice aspects to TACI used in Bell Telephone Laboratories to increase capacity of submarine cable in making use of frequency channels of voice in voice communication. Letters, numbers, words and even between available. The AFCE approach requires a "phonetic-to-code" which converts speech into digital form to permit its transmission at



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varying data rates and provides an indication of speech activity for control in section of Teletype data during silent periods. AFCEC tests indicate that during normal two-way voice contacts from more than 50% of the channel capacity is available. For simultaneous transmission of Teletype and data, in coding to Caldwell South of AFCEC's Data Sciences Laboratory.

► **Super-power Tube Development:** Semi-Monotone tube compares as competing about the sharp drop-off in Defense Dept. funding for research and development in the field of super-power tubes which is down about 85% from its Fiscal 1961-62 peak of about \$12 million annually. Power tube now available appear to meet anticipated requirements for early warning and missile defense.

► **Why Navy Pushes For Reliability:** Navy's maintenance and reliability efforts has dropped 75% in the past eight years in terms of number and experience level, and a similar drop is predicted for the next eight years, according to Navy spokesman. During its recent East Coast Conference in Annapolis and Naval Station Electronics, J. M. Barclay, head of advanced systems development for Bureau of Weapons Systems Branch, told these figures explain Navy's push for increased reliability and growing use of computers for automatic checkout. He said that only one out of five aircraft in the Navy inventory is ready for combat at any time, the other two are undergoing maintenance. Three years ago the figure was only one operational out of four. Barclay said the Navy currently spends 40 millions of maintenance effort for every hour of flight.

► **Hot Electronic Amplifier Placed:** Glass-coated and experimental developments into materials and techniques set the stage for a new generation of electronic devices. Hot electron amplifier, as planned by USAF's Aeronautical Systems Division. Qualified companies who wish to bid should contact Code ASKS and reference RFA4460-94-14.

► **Rare Earth Rare Light-Transmitting:** Rare earth phosphor light has been achieved using non-earth phosphor glasses, according to Bell Telephone Laboratories. CR-11 glass is an optically transparent, phosphorescent, transparent and disposable product that provides the greatest solution, possibly better than other glasses at room temperature and 140 times as much when operated at liquid helium temperatures. The results. The phenomenon suggests use of rare earth glasses as effective isolators in laser and optical systems.

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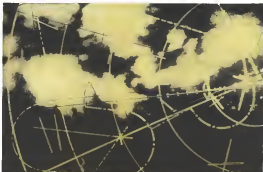
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patible with pentest and firestorm automatic pilot systems. Magnetic accuracy within 0.25 degree is achieved for use with Doppler navigators, and free gyro operation may be selected for pinpoint grid navigation. Interchangeability of major units, simplicity of maintenance, gyros and electronics of unprecedented reliability, all add to economy or performance over the long term. ☐ Sperry has produced and sold more high-accuracy compass systems than all other manufacturers combined. Investigate with us on your current and future projects. SPERRY PHOENIX COMPANY, Division of Sperry Rand Corporation, Phoenix, Arizona.

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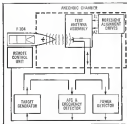


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[illegible]

## III



**RADAR TARGET SIMULATOR** which will permit rapid lightning checkout of airborne North American Search & Engage Radar (NASEAR) on F-104C interceptors is shown in block diagram (left). The beam and volume of a CF 304 are mounted in trailer containing tracking chamber (right) in checkout operation. Operator in cockpit may make tests with aid of remote control unit. Simulators for the various mission courses F-104C are being made by Electronic Electric and Research, Inc. for the CF 304, in Greenville

## Target Simulator Checks F-104G Radars

Harvey Miller

**Santa Monica, Calif.**—Lightweight, transportable radar target simulator capable of performing dynamic checkout of multibeam airborne radars in 20 min, are scheduled to be delivered to Lockheed Aircraft next spring for use in flightline checkout of the F-106 interceptors intended for the military intelligence program.

The radar target simulators are being developed by Emerson Electric Mfg Co., with Remson, Inc., which is located here, serving as a subcontractor.

The simulator will be able to properly examine all operating modes of the aircraft's NASARR radar without requiring the removal of the aircraft's radome or the need to make electrical connections between the radar and the test simulator. For biweight horizontal tubes, trouble-shooting and calibration, the radome must be removed to make necessary electrical connections. Calibrating the radar requires approximately 1 hr.

Each overlander consists of a small (4 x 5 x 13 ft.) timber-mounted room with an airtight chamber containing a pair of adjustable test windows and optical height targets, with acoustic and control equipment located in drawers at the sides of the trailer. The latter can be rolled into position on the highway or in a hangar, and the aircraft's pressure and volume inserted into the chamber through its breaching door.

ular Absorbent material covering the inside of the chamber absorbs the RF energy during tests so as to simulate realistic free-space conditions.

Bought alignment mechanisms on the trailer drive the chamber and target sensors away into alignment with the aircraft radar line in response to signals from a remote control unit, which the operator takes into the cockpit with him.

When the aircraft radar transmits during (default, an automatic frequency control (AFC) and detector loop (simplified block diagram, above) lock onto the radar signal. The AFC can operate under frequencies within 25 kHz, according to Rotunda. The target analyzer returns the RF signal, normalizing its frequency, pulse shape and width, range delay and power level (the type of target returns the radar would use in each of its modes).

However, for test antennas used as scattered receive equipment function as follows: as a transponder. Returns are transmitted by one or both of the test antennas positioned so that they radiatively simulate the types of returns expected for operation in a given NASARR radar mode.

Changes in range, velocity and position of the target are immediately controlled by the operator in the master cockpit. He monitors radar data detected and displayed on the remote control unit. He can check the transmitting, receiver and computer functions in all modes of operation. Two consoles

are expected to be used with each F-104 squadron in the military aircraft prototype activity, according to Edwards.

Among the operational rules noted that the operators will check are the following:

- **As-to-Air-Air**—Target pulse of the necessary width, range and power level to illuminate the desired airborne target is generated by the radar test generator. One of the two target test sets is then selected as a criterion for the target tracking capabilities of the receiver. Various factors evaluated include lock-on, range and angle tracking, information presentation, post tracking clutter elimination and resolution.
- **As-to-Air-Ground**—Terrain elevation—This test determines the ability of the radar to differentiate terrain elevation during flight by generating a pulse to illuminate beyond ground targets. Range, power and test unknown depression angle, and test unknown elevation angle are considered. If any of these radar operations for different distance planes with the target appearing in the upper and the lower antenna elevation beams at different angles, according to the com-
- **As-to-Ground**—Two specialized tests evaluating a ground system provide for check-out of range tracking and computer performance for the air-to-ground mode. Pulse width and RF amplitude programmed as a function of range and range gate number return given range.
- **Ground Map Evaluation**—Severe test

• **Constant Mapping Yarns Avoidance**—This test determines the ability of the rufes to indicate terrain clearance during flight by generating a pulse to indicate typical ground heights. Range, power and test antenna dipersion angle are set to polypotential values. Vased conditions are used to check rufes operation for different clearance planes with the target appearing on the upper and the lower antenna elevation beams at different ranges, according to the con-

- **Air-to-Ground**—Two sequenced signals involving a ground return provide for checks of range finding and computer performance for the air-to-ground mode. Pulse width and RF amplitudes programmed as a function of range simulate a ground return for given distances.

- **Command Map Evaluation—System are-**

MIT/RAYTHEON STATUS REPORT:

# APOLLO Guidance Computer



Ralph Boyan (left), Manager of Raytheon's Saffery Operations, and Eldon Hall, Director of Apollo Computer Division, MIT Instrumentation Lab, inspect on-board guidance computer for Apollo mission.

## Predicted Reliability Increased More Than 2:1 ... Contract On Schedule

By incorporating the latest rope memory module and integrated micrologic techniques into Apollo's on-board guidance computer, the MIT/RAYTHEON team has doubled predicted reliability of the system with no loss in scheduling time.

Drawing upon a background of successful joint effort in developing the reliable Mark 2 Polaris missile guidance computer, the MIT/RAYTHEON team is striving for similar fault-free operation of its Apollo guidance system. The operating computer, less than 1 cubic foot in size, will provide mid-course navigation and guidance data for NASA's Apollo spacecraft mission.

The MIT/RAYTHEON-developed computer contains an extremely dense, low-powered, fast memory of 5,000 bits/cubic inch. In flight, the astronaut will operate the computer through a 36-button coded keyboard. In case of input error or an "unacceptable" order, a light will warn the astronaut to erase the error. When the command is correct, he pushes an "enter" button and the computer will take over, using inputs fed to it automatically from the other subsystems in the craft.



Keyboard for Apollo's on-board guidance computer.

The working relationship of the MIT/RAYTHEON team in developing and producing the computer, its displays and keyboard, and its pre-flight ground support equipment, represents a truly unique capability in space age guidance and control. Space and Information Systems Division, Saffery, Mass.

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velocity, indicator alignment, instrument range and receiver gain controls, antenna tilt, intracode shift and more are evaluated on a ground map unit. With the target at different windward angles and changes in reference, proper accuracy is achieved to check intracode operation. Beam operation is tested by checking indicator for both gain and speed (feet/s) beam operation.

The Reference Receiver simulator system takes use of what is called transition time testing. The transition time is that portion of the radiation field of a directive antenna like the one employed for the NASAR system, lying between coast and for field area.

The receiver chamber is positioned so that it encompasses the transition region of the directive radar antenna under test. It simulates free space, enhances radiation patterns and reduces interference.

Measurements are made in the chamber and correlated with what would be obtained in free space. A large chamber might more easily reproduce conditions of free space but this would, according to Reference, pose difficulties in handling, staining and covering about.

### NEW AVIONIC PRODUCTS

• Military wavelength signal generator, covering frequency range from 37.5 to 100 GHz (line), has short-term frequency stability of 5 parts in 10<sup>6</sup>. Some can be traced to fixed frequency to within 0.01%. Manufacturer: Progress, Inc., 6000 Laboratory, Pittsburgh, PA 15207.

• Fixed circuit balun, fitted to end of printed circuit board, leads the board towards one place in and out and file by means of two lines (inward), provides convenient means for



removing board without tools and applying on test points. Device is attached



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## How Solar uses electron beam welding to join high alloy and refractory metals

The heat resistance of high alloy and refractory metals makes them ideal for many of the most advanced aerospace structures. This same quality, however, makes it difficult to join these "exotic" metals either to themselves or to other metals. Solar solves this problem by employing electron beam welding.

Basically, the electron beam welding process used by Solar is a type of fusion welding. Heat is generated by accelerating kinetic energy in a dense beam of high velocity electrons to thermal energy. The electrons cause instantaneous localized melting as they hit parts to be welded. The parts coalesce, forming a strong fusion bond.

Welding operations are carried out in a vacuum. This increases contamination from air and allows the beam of electrons to be concentrated on the work without being deflected by molecules present in normal atmosphere. The

welding chamber is evacuated to a  $10^{-6}$  mm of mercury. Intrastatic or absorbed gas pressures are eliminated, producing extremely clean welds.

Solar's two electron beam welders can also be used for heating, making holes and making holes, as well as welding. The interior of the parts has a shoulder that ensures 36 inches long, 39 inches wide and 42 inches high. Extensions up to 12 ft on each side can be added to weld parts such as missile ducting. In a year and a half of operation, the electron beam welders have been used to weld 1600 jobs—some representing as many as 59 welds.

A partial list of metals joined by Solar with electron beam welding includes columbium, tungsten, molybdenum, titanium, stainless steel, Hastelloy, Inconel, zirconium, tantalum, silver, nickel, chromium and cerium. Dissimilar metals that have

been joined by electron beam welding include copper/titanium steel, molybdenum/titanium, molybdenum/stainless steel, tantalum/copper, copper/titanium and carbon steel/stainless steel.

Electron beam welding is typical of many advanced techniques that Solar uses to fabricate the most complex aerospace components. The company has been in the forefront of metallurgical technology for over 50 years, handling with ease the most challenging space age assignments. For more information about aerospace capability, write for brochure available from Solar, Department L-194, San Diego, California 92122.



to circuit board by means of three roller pins. Extrusionlock is made of tough, radiant Lexan plastic, is available for circuit boards 4-6 inches wide in 4-in. increments or larger sizes on special order. Manufacturer: Advanced, Palo Alto, Stanford Industrial Park, Palo Alto, Calif.

• Matched hybrid, Model FIV, covers decade of frequencies from 20-200 mc., providing outputs balanced to within 0.2 db and phase balanced to within 1 deg. Isolation is greater than 40 db, insertion loss is less than 0.5 db and VSWR is quoted at less than 1.1.



Hybrid stainless approximately 1 ft x 1 ft x 4 in. Manufacturer: Adams-Russell Co., Inc., 280 Bow Hill Road, Waltham 54, Mass.

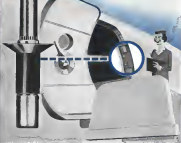
• Ultra-rugged servo accelerometer, Model 5110, a transducer beam-foam balance servo type which has accuracy quoted at 0.1% bias only one



moving part, a hinge to which a torque coil is attached. Shock is available in continuous range of 0-10 g in 100, 1000 or 10000 g/sec. 0.005% full scale and provides infinite resolution. It is available in a choice of operating parameters. Manufacturer: Syntex Deener Corp., 328 Galindo St., Concord, Calif.

• Miniwave d.e. amplifier, Model 1015, with greatest gain up to 180, bandwidth of 100 kc and drift quoted

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Checkout procedures on a newly manufactured space vehicle—its every component, subsystem and finally, complete system—have until recently been a monumental task. The complete performance of each item was recorded, then either processed and analyzed using tedious manual techniques, or run through computers, translated into digital language, and then manually interpreted and compared with predetermined optimum standards. Two to three weeks often elapsed before final approval could be given.

With the Lockheed-developed AUTO-GRAPH system—Automatic Data Recording and Processing Equipment—checkout time has been cut to a few days. The key to this time and labor saving system is simple: A "liter" device has been

installed between the checkout signal and the analyst. AUTO-GRAPHS thus produces an "exception" report—a printed tabulation of vehicle functions not performing within preassigned limits. This advanced technique—which makes use of a real time, on-line digital computer—eliminates the need to manually examine some 90% of the data.

With this system, engineers at Lockheed Missiles & Space Company are now able to process data at the amazing rate of 40 Kc in real time. Based on these principles, Lockheed is also operating the RADIS system, currently performing launch readiness functions at the Pacific Missile Range. A further extension of this concept is being developed to process the telemetered signals of a vehicle in flight.

**LOOK AT LOCKHEED... AS A CAREER.** Consider Lockheed's leadership in space technology. Evaluate its opportunities—such as the Palcos refuse and the Agena vehicle's superb performance records. Examine its outstanding advantages—location, advancement policies, creative climate, opportunity for recognition.

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at least than 100 screws per day. C uses flat low jacking components and directly mounted drive elements—ultra-quiet diodes and transistors. Drive measures 0.75 x 0.55 x 0.18 in. and including leads. It is designed for operation over temperature range of -90C to 100C, requires supply voltage of +12 v and -12 v and has input impedance greater than 10,000 ohms. Manufacturer: Hayes Inc., P.O. Box 546, 33 Squawak, Calif.

• High-performance reproducing unit, Type HB-120, powder 50 920, uses field generating capacity than resistance-inductance unit, has 31% more current carrying capacity and offers



33% greater length per pound. Most used maximum critical field strength is 120 kGauss. Continuous length up to 50,000 ft. will be available in 0.010 in. dia. wire. Manufacturer: Westinghouse, Pittsburgh Manufacturing Div., Blueville, Pa.

• Phase shifter for 400 cps voltages, Model PG 3, designed for power movement, permits shifting up to 160 deg.



without introducing amplitude variation. Phase shift accuracy is quoted at 20 mV of use. Device measures 3 1/2 x 2 1/2 x 3 1/2 in. deep. Manufacturer: Theta Instrument Corp., Southbrook, N.J.

• Laser energy monitor, Model MI-2, permits measurement of energy during laser operation by beam sampling technique which permits laser to perform its intended function. Monitor provides

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HELICOPTER AGRICULTURAL OPERATIONS are expanding into areas previously dominated by fixed-wing aircraft, because of conditions where rotary wings are more productive. Heller 119E, above, is delibating cotton in Texas. Its descendants help spray potatoes.

## Agricultural Aircraft—Part 2:

# Helicopters Invading Agricultural Market

By David A. Brown

Increasing interest in the agricultural market as a possible career source of revenue for helicopter manufacturers has so far resulted in a number of study and development programs, an increase in sales activity directed at rural application operators and at least one new helicopter.

The rotating industry as a whole is working to displace the fixed-wing agricultural aircraft in favor of the rotorcraft as the dominant (JAW Nov. 18, p. 146).

### Optimistic View

Bell Helicopter Co., which expects to have 5% of its total civil production go into agricultural work this year, is possibly the most optimistic of the major helicopter manufacturers in this regard.

Bell's agricultural sales were only 1% to 2% of the company's civil production as recently as two years ago, and sales personnel who speculate in the agricultural market believe the helicopter is on the verge of an even greater breakthrough.

Benefit Helicopter Corp. evidently

shares this belief, for it is developing a new helicopter designed specifically for agricultural work. This helicopter is to be based on the four-place Buehrle 101 (JAW Oct. 16, p. 151) and have a different rotor system, designed to provide extra lift in the expense of speed.

### Early Development

The company says the first hardware will not be available until October, 1968, and the first flight probably will be some time after that.

Irving Greenberg, Benefit president, believes that the agricultural helicopter industry is still in the Model T stage, with much room for development.

The company hopes to be first on the market with a strictly agricultural machine, but Greenberg notes that he has no plans to spread the small Buehrle team too thin. The new Model 105 has first call and when it is completed and ready for the market, the agricultural machine will be covered up in parallel. In addition to a light-duty rotor system, the agricultural helicopter will have a fuselage adapted to carry heavy loads and which can be easily changed.

A purely agricultural helicopter could be a further step in a trend noted also

by Bell of an expanding of helicopters used in agricultural work.

Bell market specialists have noted that the equipment now being used for this work is heavier than its previous version, has better operating efficiency, has considerably fewer operating costs and better pilot handling characteristics than older models formerly used.

Even though agricultural helicopters now still be outcasts from other work, they are trading faster to be better machines, Bell notes.

### Increased Efficiency

Bell says that 1963 was the first year in which rotary-wing aircraft were able to take business directly away from fixed-wing airplanes and attributes this to increased efficiency of operations and operating cost.

A portion of Bell's sales now is going to operators who formerly used only fixed-wing aircraft. One example is an operator in Cleveland, Ohio, who purchased his first helicopter three years ago as an addition to his fixed-wing fleet. Now he operates eight helicopters.

There are a number of other instances in the past few years, Bell has noted, where operators have been pur-



NOZZLE ARRANGEMENT ON SPRAY BOOM is evident on Bell Model 470 (upper left). Heller 119E sprays potatoes (upper right) from 140-gal. tank. New Sycamore meeting with willows. Fuselage is based on Hughes 369A (lower left). Jenson 4A (lower right) is cane.

chasing their first helicopter to go with a fixed-wing fleet.

Research sponsored by Bell shows that the domestic agricultural helicopter fleet has increased about 51% in three years, from approximately 120 machines in 1960 to about 180 now.

### Foreign Growth

In foreign countries, the rate of growth may be even faster than in the United States, although specific figures are difficult to get. In Japan, for example, there are about 48 agricultural helicopters and the Japanese are then are increasing the number by about 20 a year as they expand their work throughout Asia.

In South Korea, domestic agricultural operations by helicopters increased about 900% during the period from 1955 to 1964, whereas the total hours flown by fixed-wing aircraft actually decreased slightly during the same time period.

In 1955, helicopters flew only about 15,000 hr in agricultural work, and fixed-wing aircraft flew approximately 841,960 hr. In 1964, helicopter hours flown in agricultural work increased to approximately 90,000, while fixed-wing hours declined to about 639,100.

Bell has been pointing out to operators that while helicopters are more costly to maintain and to purchase, their increased workload capability is



BELLER 119E SPRAYING POTATOES shows versatility of helicopter when used over rough terrain. Helicopter manufacturers are optimistic as their chance in the market.





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patrol. Of heli helicopter hours contracted by these companies, 85% were devoted to night-vision control.

This ability to operate over more rugged terrain than fixed-wing aircraft was making the helicopter consider secondary more than competitive, Heller believes, noting that a number of California agricultural operators have added one or more helicopters to their fixed-wing fleet in recent years.

Another factor which Heller believes is helping back agricultural use of helicopters is that the agricultural market-capturing government or large industrial economies is not organized and is rather difficult for helicopter operators to contact.

These operators mostly have limited sales promotion facilities and Heller has not met a pest-control effort using non-aerial use of agricultural work for advertising aircraft.

This tends to increase the cost of sales and discourage the smaller helicopter operators, who are making their living on what is considered a more secure market based on industrial, government and defense work.

In addition, the cost of ground support equipment, including pits, open pits for the helicopters and, in some cases, special harness, also runs up the expense of operations.

### Competitive Advantage

Show rig equipment for helicopters has been improved and perhaps have doubled in the past 10 years for smaller helicopters. Heller believes that helicopter technology is moving faster than other competitive fixed-wing technology and that this will continue to work to the advantage of returning aerial applications.

Heller looks for the agricultural market to increase, especially if charter options find methods and facilities for better promotion of their capabilities. The company suggested, for example, that charter operators use cellular contacts with chemical companies and distributors in order to avoid having their services through them to the agricultural market.

First deep helicopter penetration of the agricultural market (as distinguished from forest work) will be in areas where rough terrain, paddocks, where deep penetration of the chemical is desired—such as cotton, alfalfa and alfalfa discomers—in which the rotor downwash will aid and where fixed-wing aircraft would have to operate from fields a considerable distance away.

The ability of helicopters to operate off unprepared fields of numerous length is counted by Heller as a major competitive advantage over fixed-wing aircraft. With less ferry time to and from the operating site, the total cycle

costs less in time and money—on important sales factors.

Another advantage, as Heller sees it, is the helicopter's ability to provide better coverage of crops despite such obstacles as powerlines, fences, hills or trees.

For example, Heller cites the comparison cost of California broadleaf berries and crop spraying, based on a 10-gal/acre application of 3.4 lb growth hormone. Cost for application by a fixed-wing aircraft would be \$120 per acre, while a helicopter would cost \$8.50/acre.

### Recover Lost Crops

However, if the fields were obstructed in some manner, fixed-wing aircraft could miss stretches of the crop so that the lost yield would offset the cost/acre differential.

A relative newcomer to the agricultural market, the Hughes 269A helicopter, is seeking a strong hold in the marketplace in this field.

A spin system for the machine was developed by Agricultural Aviation Engineering Co. (Agriculture of Santa Clara, Calif.), which has a 25-ft. boom and delivers a 10 to 40 lb. spray. The spin system employs a pair of 30-gal chemical tanks.

Hughes has conducted tests with the 269A over a flat field in competition with a modified Stearman biplane. Results indicated that the two were approximately equal in the work performed.

The 269A dispersed 1,365 gal/acre and the Stearman 1,294 gal/acre. The helicopter covered 107.5 acres/hr and the fixed-wing aircraft covered 109.4 acres/hr.

Tests were based on a 5-m. feet distance for the Stearman. The two were both quarter mile and half mile in length and the two aircraft each had driven a 40-ft swath with 10 gal/acre coverage.

### Covers 20 Acres

Fixed-wing speed over the run was 90 mph, and the helicopter speed was 60 mph. Tank loadings of 45 and 60 gal were used on the 269A and 150 and 192 gal were used on the Stearman aircraft.

Hughes calculates that the 269A will cover up to 20 acres with a 10-gal load based on a speed of 85 mph and an application rate of 5 acres/min. Two round time between refills is considered 5 to 7 sec., compared with 24 sec. for the Stearman.

At present, about 70% of the 269As in service are used in agricultural work, at least part-time. Company officials hope that this will increase to about 90%.

Certified, but not yet in production, is the Beech 44 tandem rotor heli-

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## Chicago Wife Is Georgia Church Greeter

By Doris Lockerman  
Atlanta Contributor

"GLERC," smiled Mrs. Philip Sygna, "may be a funny word to you, but it's a very good one in our lives. Practically everything we do centers around it."

GLERC are the initials of the Georgia Lockhead Employees Recreation Club, open to all the plant's employees, with a membership fee of \$10.00 and a \$1.00 annual dues fee. It is a place where they can relax and enjoy themselves.

Philip Sygna, 35, Lockhead employee, at his job in the plant's main building, GLERC facilities, is not an average Lockhead. He will be his wife's next.

The two Sygnas, Mrs. Larry, 34, and Philip, 35, are family members of the GLERC plant club, and the club's first meeting was held on a regular basis.

While Mrs. Sygna, who was born in Poland, has a husband who is a member of the club, she has a husband who is a member of the club, and she has a husband who is a member of the club.

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script designed by the Jovian Corp. of Culver City, Calif.

The helicopter carries 50 gal. of chemicals in a non-pressurized tank, which can use Agusta's spin equipment. Cargo compartment holds 18 cu ft. of equipment and foldable side racks can double this amount.

The Jovian 4A is certified under CAR Part 1 for a gross weight of 2,100 lb. and when certified under Part 8 is complete, this will be increased to 2,500 lb. (empty weight is 1,340 lb. and cruise speed is 75 mph).

Powered is a Rotax (A115) engine of 210 hp. An optional 255-hp engine is being fabricated for altitude work, and an autopilot also is being tested. Price is about \$50,000.

D. Jovanovich, Jovian president, said had scaling is completed at the company's factory but that the helicopter would be built only to order.

(This is the conclusion of a two-part report on agricultural aircraft. Part 1 appeared in AVIATION WEEK & SPACE TECHNOLOGY Nov. 18 p. 105.)

## WHO'S WHERE

(Continued from page 25)

### Changes

Lewis S. King, associate head, Communications Section and Techniques Dept., The Navy Corp., Bedford, Mass.

Jack G. Webb, special assistant to the associate administrator for programs of the Federal Aviation Agency, Washington.

Dr. Jacob Kormanik, chief scientist, Office of Research, Sea Research (OSR) Dept. of the Navy, Corp., Office for Naval Research, Washington.

Dr. James J. King, senior staff scientist, Sea and Submarine Systems, Dept. of the Navy, Corp., Office for Naval Research, Washington.

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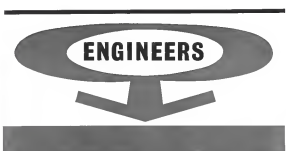
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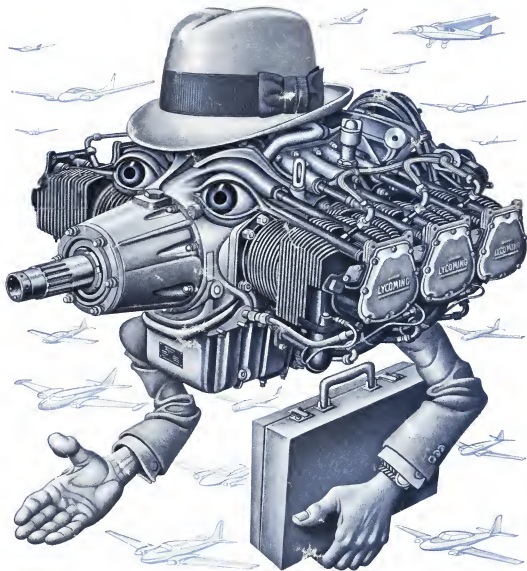




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